JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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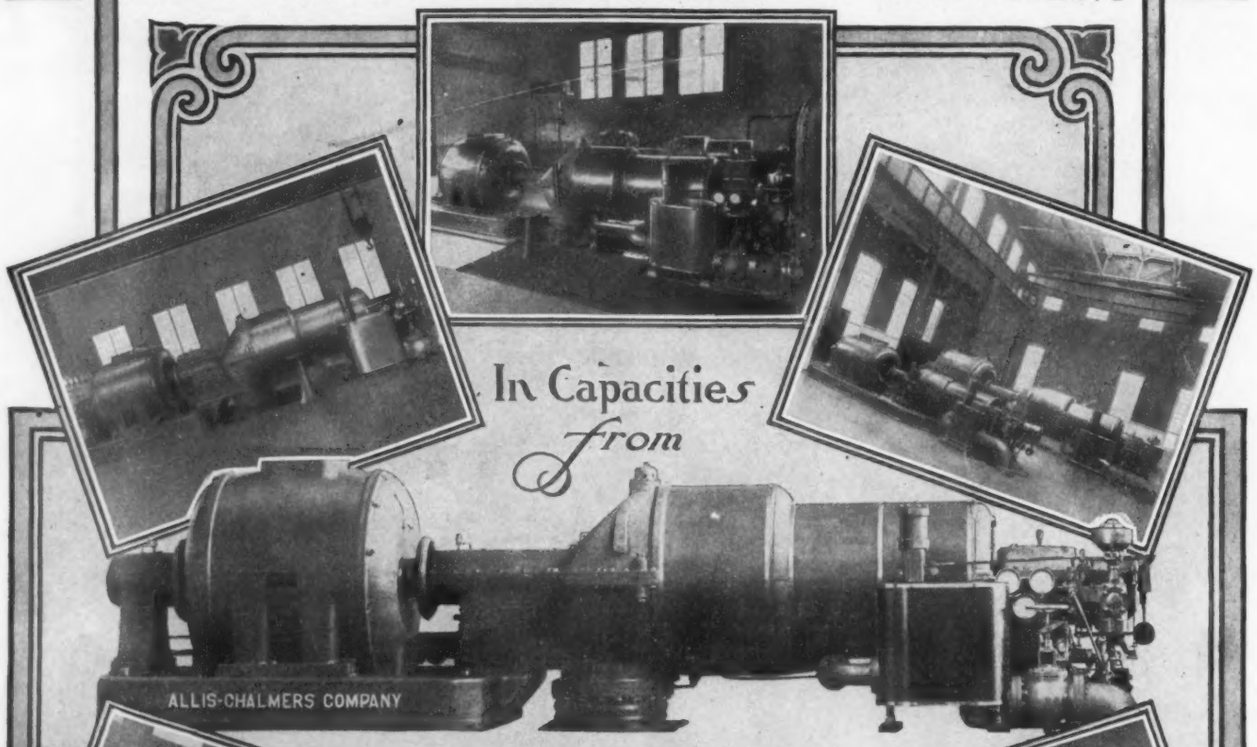

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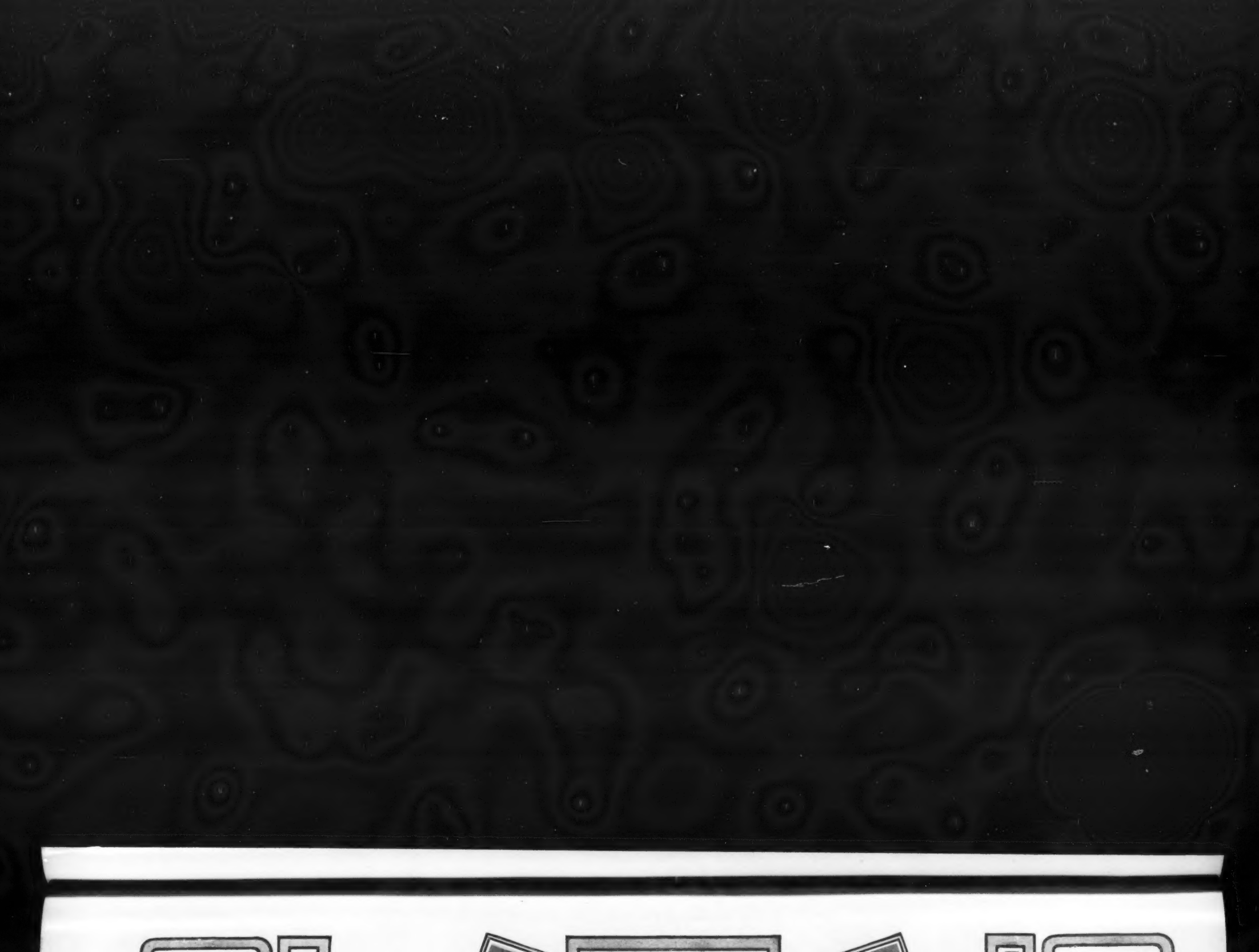

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POWER AND GAS

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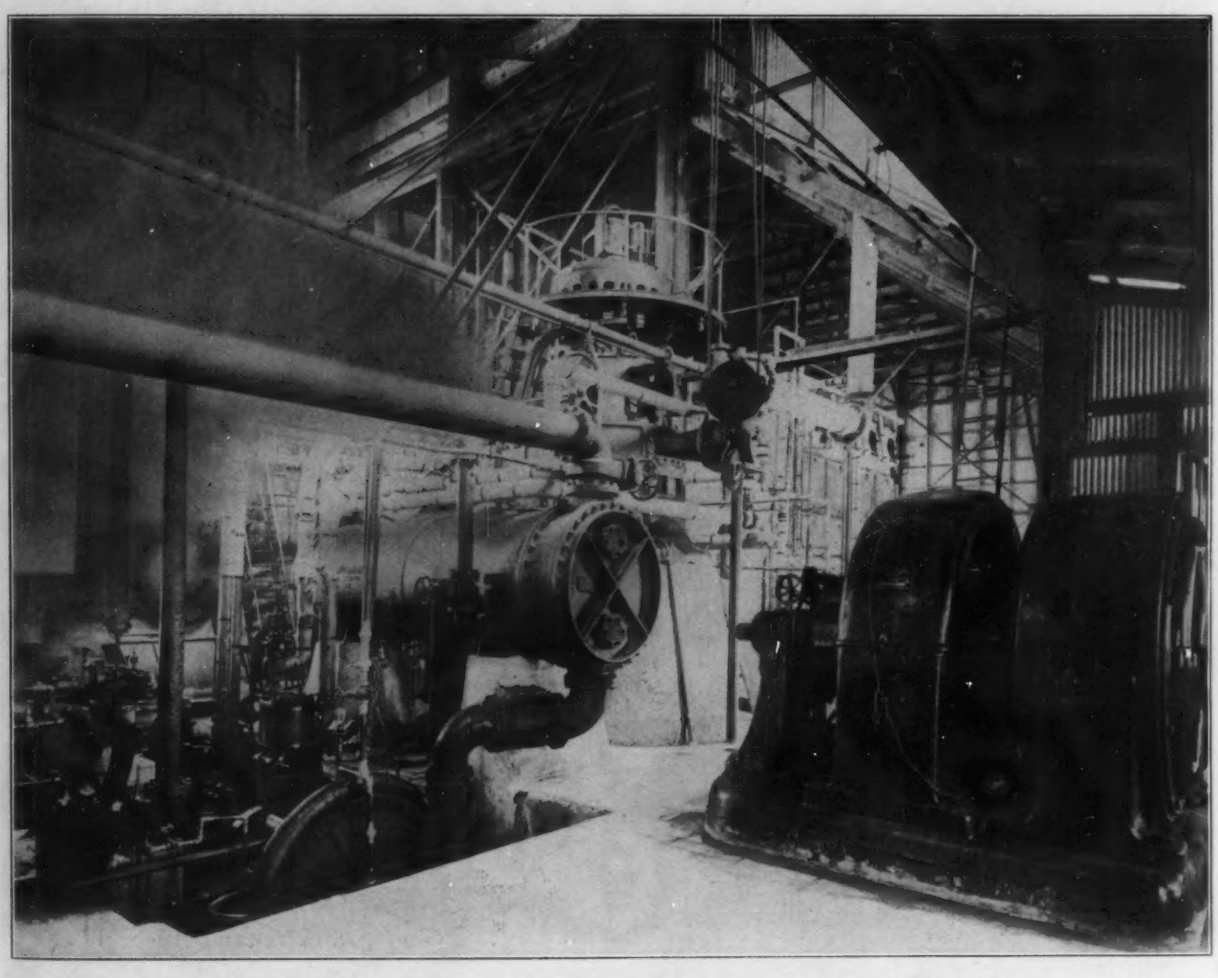
SOME PRACTICAL CONSIDERATIONS CONCERNING THE CHOICE OF PRIME MOVERS.[1]

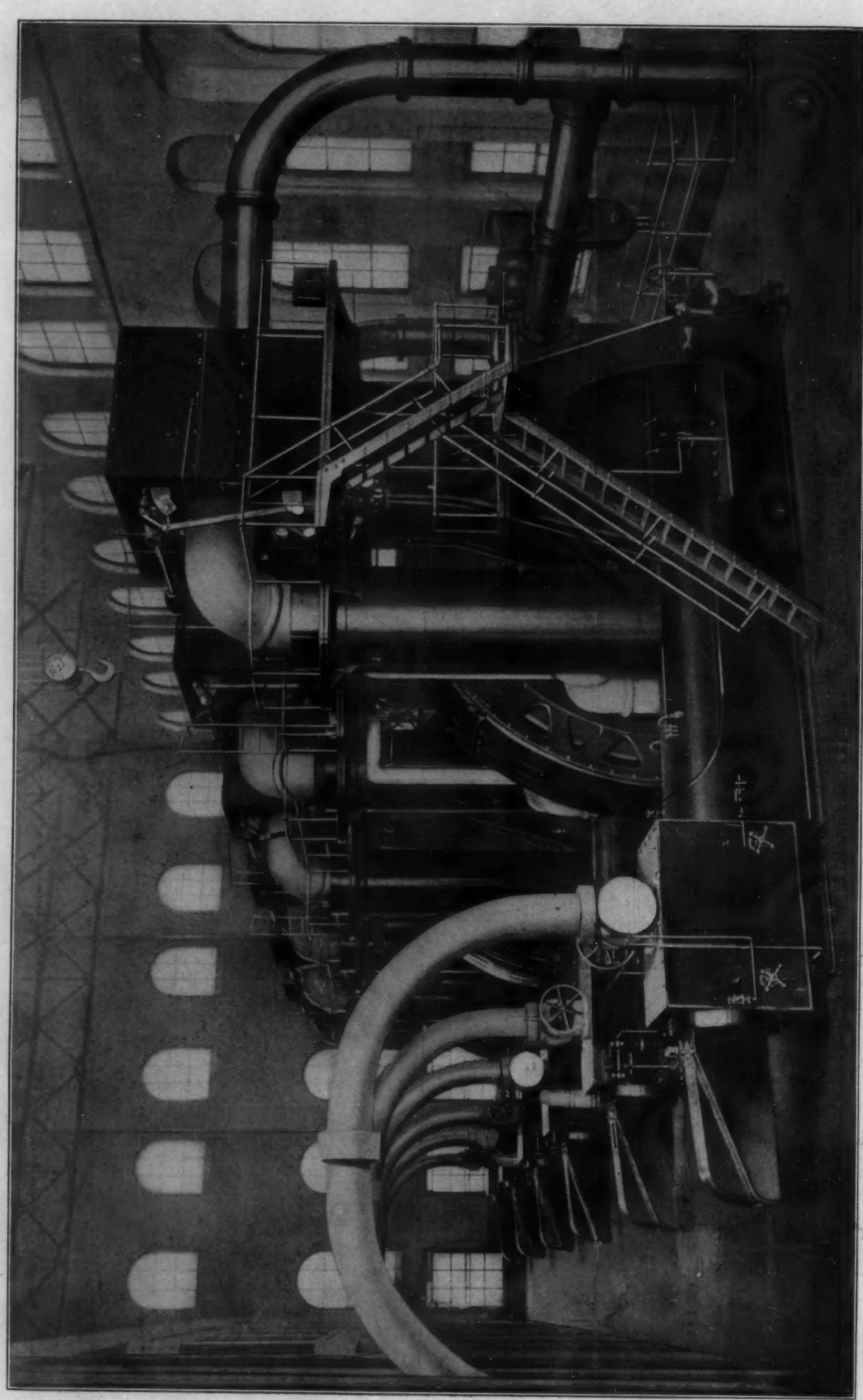
BY W. B. GUMP.

The object of this paper is to deal with the practical side of the question of selecting prime movers, basing the arguments for or against a particular type upon actual operating conditions as they exist at present in some of the best known plants. It is well to state here that the criticisms offered with reference to certain types destined to operate under a given set of conditions, have been based upon results gathered from some of the most prominent power plant superintendents and operating engineers. These results point to certain conclusions. The conclusions which many draw, however, are found to differ with the individual.



Steam Turbine and Auxiliary Equipment, Monterey County Gas and Electric Company.

[1]Paper read before Los Angeles Section American Institute of Electrical Engineers, April 20, 1909.



Reciprocating Engines in Redondo Plant, Pacific Light and Power Company.

and are for the most part at variance among engineers to such an extent that the selection of prime movers is bound to remain a more or less perplexing problem.

Since the greatest source of loss in the power station is to be found within the prime mover this piece of apparatus has constantly received most careful attention. Reliability is fully as important as economy and in a large power station both are necessary.

Considering first the steam prime mover the question of the steam turbine versus the reciprocating engine at once presents itself. Not a few engineers have attempted to settle this question once for all, advocating one type for practically all power plants. The disciple of the steam turbine is rather reluctant to admit that a reciprocating engine should ever have been born, and vice versa. As a matter of fact, each type possesses certain advantages over the other, and in making a choice these should be weighed carefully with reference to the specific conditions in hand.

The reciprocating engine, although considered quite unfit for many plants, is bound to perform valuable service for a great many years to come. Steam pumping plants will, for example, continue to use reciprocating engines, as will also a great many mills and factories in which the speed conditions demand such a type. The steam turbine, however, is an active competitor of the reciprocating engine and is already supplanting the latter in many places where it formerly held "full sway."

It should be remembered that while the steam turbine is probably the oldest form of heat motor, yet its practical utility has been realized only within recent years. During this time a great many difficulties have appeared in the commercial working of the turbine, and it may be said that many of these problems are but partially solved. The cost of developing the steam turbine to its present state has been so great that only the larger manufacturers have been able to handle turbine installations on a commercial scale. The early operation of steam turbines in various power stations revealed their weak points, many of which have been remedied in subsequent machines. Certain objections demand further changes before the turbine may be said to have reached its highest state of development. For this reason it is not unreasonable to suppose that a steam turbine plant erected today is not unlikely to be further out of date five or six years hence, than a reciprocating plant. The many advantages of the turbine, however, and its satisfactory operation in a great many plants are sufficient evidence to show that the question of future development has no direct bearing on present day turbine installations as far as a handicap is concerned.

The field for the steam turbine is essentially that of high speed direct drive. It is its adaptability to this class of service which so eminently fits it for the generation of electric power. Small floor space, freedom from vibration, absence of oil in the exhaust steam, and—above all—the ease with which synchronism is affected, are factors which contribute to its favor for power station work.

With regard to steam economy as compared to the Corliss engine there is still some discussion. Tests have shown some excellent results, especially those made on large turbines. Curves obtained show a comparatively low steam consumption per k. w. hr. over a wide range of load. A steam turbine is not economical, however, on a low vacuum. Steam turbines therefore demand the very best class of auxiliaries if steam economy is to be attained. Otherwise the steam consumption is apt to reach a prohibitive value.

In view of the fact that turbine economy is a function of vacuum the cost of maintenance on auxiliary apparatus for steam turbines is an item of great importance. As to the present status of Corliss engine operation it may be stated that even with large units it is not always advisable to carry the vacuum beyond 27 inches, for the reason that the cost of maintenance on auxiliaries is likely to offset the advantages of lower steam consumption. A steam turbine of less than 1000 k. w. is not likely to show better steam economy than a first-class compound engine of the same capacity, and having the same cost of maintenance. In fact, a turbine of this capacity under ordinary conditions of operation is likely to have a higher steam consumption. In this connection it should be noted that steam turbines of small capacity have relatively large clearances, and this factor alone necessarily introduces a barrier in the way of high steam economy.

In power stations which permit the installation of units of 2000 k. w. and above, the advantages of the steam turbine will usually outweigh those of the reciprocating engine, barring the latter from consideration. In a large power station the cost of the building may be reduced from 20 to 50 per cent by the installation of turbines, when compared to a reciprocating plant of the same capacity. Since the piping for a steam turbine plant is simpler and more direct, a considerable saving may be effected over that of the engine plant. It is interesting to observe both a reduction in first cost and a marked simplicity in the layout of the so-called "double deck" type of plant.

In regard to the question of maintenance it would be reasonable to suppose that the steam turbine has the advantage over the engine, and this is true where the conditions are favorable. A great many if not the majority of breakdowns occurring to steam turbines have come about from one of two causes: either their operation has been placed in the hands of an unintelligent or indifferent class of help, or those in authority have made the conditions for good operation impossible. In such cases the writer is of the opinion that it is strictly "up to the management" and cannot be laid to the fault of the turbine. With proper care (and this means the employment of responsible operators) there is no reason why a steam turbine should not give excellent service, and such service can justly be expected in plants where the operators are properly paid for their work and allowed the opportunity to give the machinery they look after proper care.

Due to the fact that steam turbine efficiency depends upon the condition of the auxiliaries it becomes evident that turbine installations cannot be economically considered where there is not an ample supply of cooling water available. For a suitable vacuum a quantity of cooling water from 60 to 80 times the weight of steam condensed is required.

As regards the question of using superheated steam it may be said that few of the up-to-date plants

above 5000 k. w. are operating without superheat. The theoretical amount of superheat required to prevent condensation is the quantity which will give dry steam at the point of cut-off in the low pressure cylinder at average load for a reciprocating plant, and for a turbine plant an amount which will keep the steam dry to the point of exhausting into the condenser.

A steam turbine is capable of using highly superheated steam to advantage. In the case of the average Corliss or automatic cut-off engine of American manufacture the safe limit to which superheat can be carried is restricted to about 100 degrees F. Higher superheats in this type of engine require special fittings. On the continent of Europe much higher superheat is employed, superheats of 200 degrees and over not being uncommon. Economic conditions in America are vastly different from those in Europe, and this is accountable for many features in connection with European plant operation not to be found in the United States. Engineering requirements in this country are such that the time for building a plant and putting it in operation is usually so restricted as to preclude many of the refinements which would greatly improve the economy.

In not a few cases the selection of prime movers is made on a basis of the time of delivery. This is particularly true of plants located at points remote from manufacturing centers. It is the tendency of many who control power enterprises to increase the output almost to the point of a burnout before any arrangement is made to enlarge the plant, with the result that before the plans for an addition are fairly under way the existing machinery is groaning under the load it has to carry.

Under these circumstances the purchase of second-hand machinery may be justifiable when considered from the standpoint of emergency, since the cost of a long delay, the cost of new machinery, and the interest on the investment may be decidedly unfavorable as compared to meeting the exigency through a quicker and cheaper means. It is needless to say that such an emergency should not be allowed to arise. If it does, however, the only method of meeting it is to consider the immediate requirements and take the initiative.

It is well here to touch upon the advantages of the exhaust steam turbine as a means of enlarging the output of existing reciprocating plants. It is well known that, due to constructive difficulties, the expansion of steam within cylinders is greatly restricted. For example, if steam at 150 pounds pressure is expanded to one pound absolute (28 inches of vacuum) the volume must increase 111 times. If this number of expansions were carried out within the cylinders of a compound engine the low pressure cylinder would require a diameter ten and a half times that of the high pressure, which for mechanical reasons is out of the question. A steam turbine, however, will permit an expansion of 150 times the original volume without difficulty. It is plain, therefore, that if a low pressure turbine be interposed between the low pressure cylinder and the exhaust pipe to the condenser, the energy which is ordinarily rejected becomes immediately available for the generation of power. By this method the present day reciprocating plant may increase its output as much as 100 per cent at comparatively small cost and with but little inconvenience. A number of exhaust steam turbine installations have been made, and a large number of others are being seriously considered.

One of the most important requisites of a prime mover is its ability to respond quickly to overloads. This requirement is of extreme importance in electric railway service, as the load conditions are as a rule the most trying to be reckoned with in any power system. That the steam turbine is well adapted to such service was demonstrated in the case of one of the large New York City plants of the Interborough Rapid Transit Company, and was described by Mr. H. G. Stott in his admirable paper on "Power Plant Economics." It may be reiterated briefly as follows: A steam turbine was thrown in parallel with a double compound engine carrying a railway load. It was noted that momentary overloads were carried almost entirely by the turbine, while the engine load remained nearly constant. In other words the action of the turbine was much like that of a storage battery. The advantages of such a combination are unusually striking, and show with what sensitiveness the steam turbine responds to the most exacting conditions of service.

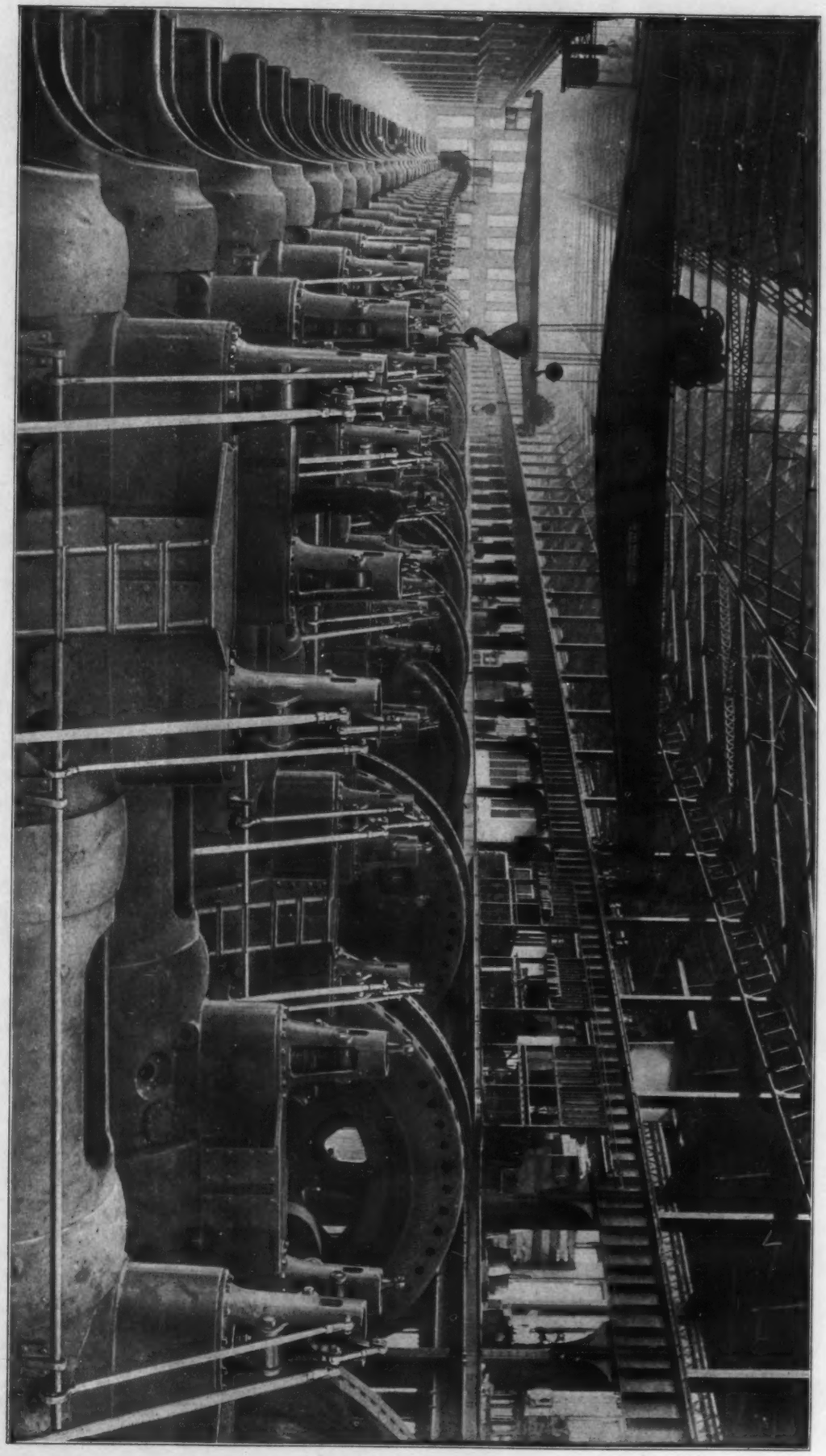
A great deal more might be said concerning steam prime movers on both sides of the case, but what remains to be said should be taken up by those amply able to bring into view many facts not even mentioned in this paper.

The advent of gas power into the central station field is not only creating intense interest among power users but is compelling most careful consideration in making a choice of prime movers in a great many localities. That the gas engine has been restricted to a certain class of service cannot be denied. Its scope of usefulness, however, is rapidly extending, and it is already supplanting the steam prime mover in many places where the latter until recently had no competition. The thermal efficiency of the gas engine is admittedly higher by 100 per cent or more, than the best compound condensing steam engine or steam turbine. The main objections to the gas engine as a prime mover for electric power plant service have been:

(1) Non-uniform speed.
(2) Inability to carry overloads.
(3) Unreliability of service.

The first item, that of non-uniform speed is of course decidedly against the first requirement for electric power service. As to the question of speed regulation there is no prime mover in existence, and never will be which is capable of perfectly uniform rotary motion. Perfect speed regulation means that after the proper velocity has been reached the acceleration must remain zero. It is obvious that this is mechanically impossible. In the case of a gas engine the mechanical difficulties of regulation are enhanced by thermal difficulties, especially those relating to the four stroke cycle. This has been overcome very largely by the employment of two or more cylinders, and by increasing the fly wheel effect.

With two or more cylinders—either in tandem or parallel—and sensitive governing mechanism, a gas



Gas Engines at Indiana Steel Company's Plant, Gary, Ind.

engine is capable of good regulation up to full load. Beyond full load there is very little margin, and as the load increases the engine will drop in speed. This is due largely to the fact that the amount of gas required to form an explosive mixture is not in direct proportion to the load, the range of economical working being from 50 per cent load to full load or a trifle above. The quantity of gas drawn into the cylinder beyond a certain point ceases to increase the power of the engine, and will decrease it with a rich as well as a lean mixture.

Mr. Stott has suggested a combination plant made up of 50 per cent gas engines and 50 per cent steam turbines, the latter using steam which is generated from boilers having their feed water heated by means of the gas engine jackets. The quantity of jacket water required by a gas engine varies from 7 gallons to 8½ gallons per brake horsepower hour or from 75 to 95 pounds per k. w. hour respectively, depending upon the initial and final temperatures. Assuming that the turbines will use say 18 pounds of steam per k. w. hour (running condensing) it is apparent that but one-fourth of the heat energy of the jacket water is available. This would be almost entirely offset by the cooling water demanded by the condensers, since the enormous quantity required in addition to that necessary for the gas engines would introduce complexities likely to annihilate the economy sought. Even if the turbines were to run non-condensing it is doubtful whether the difficulties of handling the cooling water would not increase the investment to a figure quite prohibitive for most localities. In addition to this problem there remains the fact that a power station having two totally different types of prime mover is bound to be hampered by complexities not encountered with a uniform layout.

At the present time the gas engine unquestionably offers the best solution to the problem of fuel economy. The advantages of gas power in the neighborhood of coke ovens and blast furnaces need no comment. In this case the gas engine holds the field practically without competition.

With reference to the first cost of a gas power plant as compared to a steam plant Prof. R. H. Fernald has drawn the following conclusions: Gas engine plants of less than 1000 horsepower capacity are from 15 to 30 per cent greater than corresponding steam plants. Due to lower cost of operation this difference may be made up within from two to three years. With plants of from 1000 to 5000 horsepower the first cost favors steam from 5 to 15 per cent, the difference being made up in from one to two years. In the case of plants of more than 5000 horsepower capacity the initial cost is approximately the same for both types. The result is therefore a gain both in efficiency and in cost of operation of the gas power plant.

A 5500 horsepower gas engine plant has been constructed for a total cost per horsepower of $73. The same plant considered steam upon which a bid of $74 per initial horsepower was made. These figures seem to point to but one conclusion as far as plants above 5000 horsepower are concerned. In the commercial working of gas power plants there still remain certain obstacles which are of a sufficiently serious nature to cause some doubt as to the question of continuity of service. Some serious problems remain to be solved in connection with the gas producer before that part of the plant may be said to have reached its highest state of satisfaction. The rapid extension of gas power, however, especially in connection with some of the largest power projects are answers to the question of reliability.

TRANSMISSION LINE FORMULAE.

T. R. ROSEBRUGH, M. A.

In making any calculation one may hesitate between a method which neglects quantities that may possibly need to be taken into account, and one which while dealing completely with the problem, is more laborious or intricate, and thus increases the chances of error. The advantage of the method to be described is that it permits a middle course, yielding first a rough result coinciding with that of simpler expressions, to be followed subsequently as far as may be desired, by rough approximations rapidly converging to the true result as term after term is estimated.

The result may be obtained graphically or analytically as may be preferred by the following method.

First reduce the problem, if it relates to three-phase transmission, to one of single phase.

If the connection be star, then in so far as the fundamental is concerned, the neutral points (one at each end) will be at the same potential, and may be treated as if in immediate contact. One-third of the power may then be taken as transmitted by each conductor at the voltage which exists between it and the neutral point, that is line voltage divided by $\sqrt{3}$.

The resistance and reactance are seen to be those of one conductor only, while the capacity and leakage conductance, with which we have to do are estimated as the individual branches of a star connection having their common terminals on an imaginary neutral carrying no current.

In the calculation it is indifferent whether the actual arrangement be delta or star.

It is not the purpose of this paper to deal with these line constants, but a few words of caution may not be out of place. In using tables individual numbers may be in error, or a mistake may be made by using a table calculated on a different basis, perhaps with some coefficient not properly belonging, incorporated with it, and the special method of using such table not quoted from the original source.

Let r = resistance of one conductor.
x = reactance of one conductor.
g = leakage conductance.
b = susceptance.

If x be taken from a table, it should be, for the present purpose, one giving the reactance of one conductor at the given frequency, in accordance with

$$x = L\omega = \frac{160930}{109}\left(2\log_e\frac{2D}{d} + \frac{1}{2}\right) m\ \omega \text{ henries,}$$

where m is the distance of transmission in miles, by stating its value for one mile, or otherwise.

Also $b = C\ w$ should, if obtained from a table, be from one giving values agreeing with

$$C \times 10^6 = \frac{160930}{900000}\ m \div 2\ log_e\frac{2D}{d} \text{ microfarads.}$$

These preliminaries being arranged, and

$$z = r + x\ j$$
$$y = g + b\ j$$

adopted for abbreviation, take E_0 and I_0 to denote the vectors describing voltage and current respectively at one end of the

line, which for definiteness may be thought of for the present

as the receiving end at O in the figure, and taken as the origin.

Take E_1 and I_1 of corresponding meaning for the other end A at $s = 1$. E and I similarly may be taken as vectors for the arbitrary point on the line whose distance from O is s.

The diagram shows the convention adopted for the signs: that is, positive instantaneous values of voltage and current are taken to be of the polarity and sense respectively indicated by the + and the arrow, and relative vector senses chosen accordingly.

Here E and I being functions of s they are given thus by Taylor's theorem:

$$E = E_0 + s\left(\frac{dE}{ds}\right) + \frac{s^2}{2}\left(\frac{d^2E}{ds^2}\right) + \frac{s^3}{6}\left(\frac{d^3E}{ds^3}\right)_0 +$$

or for short, D denoting differentiation once with regard to s, D^2 twice, etc.

$$E = E_0 + s\,(DE)_0 + \frac{s^2}{2}(D^2E)_0 + \frac{s^3}{6}(D^2E)_0 +$$

$$I + I_0 + s(DI)_0 + \frac{s^2}{2}(D^2I)_0 + \frac{s^3}{6}(D^3I)_0$$

These values may be readily determined thus: With the current as at s remaining constant at the value I the vector voltage difference for the conductor would be zI for the whole length of the line, that is for unit length as we have chosen to call it, so, and consequently $\frac{dE}{ds} = zI$, or for short $DE = zI$ Similarly $DI = yE$.

Hence $D^2E = D.DE = DzI = zyE$
$D^3E = D.D^2E = DzyE = z^2yI$
$D^4E = D.D^3E = Dz^2yI = z^2y^2E$
$D^2I = D.DI = DyE = yzI$
$D^3I = D.D^2I = Dyz I = y^2zE$
$D^4I = D.D^3I = Dy^2zE = y^2z^2I^2$

Therefore $E = E_0 + szI_0 + \frac{s^2}{2}syE_0 + \frac{s^3}{6}z^2yI_0 +$

and $I = I_0 + syE_0 + \frac{s^2}{2}yzI_0 + \frac{s^3}{6}y^2zE_0 +$

In particular at A the end of the line ($s = 1$)

$$E_1 = E_0 \times zI_0 + \frac{1}{2}syE_0 + \frac{1}{6}z^2yI_0 +$$

$$I_1 = I_0 + yE_0 + \frac{1}{2}yzI_0 + \frac{1}{6}y^2zE_0 +$$

By means of these two expressions the problem (so far as fundamental frequency is concerned) may be solved as accurately as the data permit, for any length of line.

As the length and voltage increase it may be necessary to take in successively additional terms; this may be carried to any extent desired.

The first term for I, and the first two for E_1 give the ordinary solution for short lines at low voltage. The second term for I namely $yE_0 = (g + bj)\,E_0$ corrects the current for leakage and effect of capacity. The third term for E_1 corrects the drop already calculated for constant current by taking account of its variation along the line due to leakage and capacity. The third term for I_1, corrects the error made in calculating leakage and capacity effect on the basis of constant potential throughout.

At or before this point, the requirements of calculations of power transmission are likely to be satisfied, but telephonic transmission with the high frequency of some of the components of sound necessary for clear enunciation, and the long distances which are common may demand several terms more.

It is unnecessary to discuss at length the method of using this formula, as the use of complex quantities is explained in many text books.

Briefly, however, it may be stated as a caution that while the laws of algebra may be applied to the expressions given, yet if E_0 is to be taken directly as a number, I_0 (not usually being a vector in the same direction) may not be. For example, if the current be 100 amperes at O, and be lagging so as to have a power factor of 90%, then if E_0 be represented by its value in volts as a pure number, $I_0 = 100\,p - 100\,qj$ where $p = .90$ and $p^2 + q^2 = 1$.

Thus the data may for symmetry be supposed stated in the form

$$E_0 = A_0 + B_0\,j$$
$$I_0 = M_0 + N_0\,j$$

There finally result from the above described calculation

$$E_1 = A_1 + B_1\,j$$
$$I_1 = M_1 + N_1\,j$$

As line drop is stated as the arithmetical difference in value of the line voltages it will be (when only the fundamental is considered)

$$\sqrt{3}\,\sqrt{A_1^2 + B_1^2} - \sqrt{3}\,\sqrt{A_0^2 + B_0^2}$$

The power transmitted will be $A_0M_0 + B_0N_0$ watts, and that received $A_1M_1 + B_1N_1$, from which the efficiency is at once found in per cent. $100\,\frac{A_0M_0 + B_0N_0}{A_1M_1 + B_1N_1}$

The power factor at A will be

$$(A_1M_1 + B_1N_1) \div \sqrt{A_1^2 + B_1^2}\,\sqrt{M_1^2 + N_1^2}$$

Again suppose the data given relate to the point O supplying power to the other end B of the line under given conditions represented by the same diagram as before. Then as every point on a continuous line may be considered as receiving power on one side and giving it out on the other, the point O may be so considered and the conditions at B found by inserting $s = -1$ in the formula. This will have the effect of changing from + to − the sign of each even numbered (odd powered) term in both the series given.

Therefore when the vectors E_0 and I_0 are given for the point O, E_2 and I_2 for the other end B of the line of the same length as before will be given by

$$E_2 = E_0 - zI_0 + \frac{1}{2}zyE_0 - \frac{1}{6}z^2y_0I +$$

$$I_2 = I_0 - yE_0 + \frac{1}{2}yzI_0 - \frac{1}{6}y^2zE_0 +$$

These may be dealt with similarly.

WILL BUILD TUNGSTEN REFINERY.

Operations on the Melvin group of tungsten claims at Round Mountain, Nevada, aggregate a total of 850 feet of work in the three crosscut tunnels which have cut a belt estimated to be from 150 to 175 feet wide containing a large number of veins and stringers carrying from three to 36 inches of tungsten ore. The three tunnel dumps have several thousand tons of ore which will average $25. At least 50 veins have been cut in the three tunnels of varying width. The values run up from $6 to $300 a ton at a conservative estimate. There is a large amount of ore that will average 12 per cent and make a fine milling product. Manager Gohlin expects to start a raise in No. 3 tunnel 150 feet in from the mouth of the tunnel. The raise will be 175 feet to the surface. The glory hole method will be used in handling the ore, chuting down into the tunnel, where a grizzly will be used to good advantage in preparing the rock for use at the mill that is now a certainty. The style of rollers for the mill have been decided on and are now being manufactured. Manager Gohlin is also in communication with machinery manufacturers in the East arranging for a new and improved style of separator, and when the details of that are settled the plans for the mill will soon be under way and Round Mountain will soon be known as a producer of tungstic acid and have the honor of possessing the second mill in the United States for the production and treatment of that useful metal. The only mill now refining tungsten ores is situated at Boulder, Colo. Plans are also under way for building a mill at Spokane, Wash., to treat the tungsten ores produced at Murray, Idaho, and Deer Park, Wash.

PRELIMINARY DESIGNS OF TURBINE INSTALLATIONS.[1]

BY N. BAASHUUS.

From the effective head H in meters and the quantity of water Q in cubic meters per second, the total output of the turbine is approximately,

$$N' = 10 \times Q \times H$$

At the present time the two types of turbines most used are the Francis turbines for heads from 1 to 100 meters, and Impulse wheels for heads from 50 to 500 meters.

The efficiency of the Francis turbine for any given case can easily be found for any effective head H in meters; any desired output N in horsepower, and any number of revolutions n per minute. These three factors form in a certain connection a constant figure, the so-called characteristic, from which the efficiency of the turbine can be judged. This constant reads as follows:

$$k N = \frac{n}{H} \sqrt{\frac{N}{\sqrt{H}}}$$

the value of which can easily be figured out by means of the slide rule. The characteristic by any given head is in direct proportion to the number of revolutions and to the square root of the output. The output and number of r. p. m. are factors determining the dimensions of the turbine and with these the losses change so that the characteristic forms an expression for the efficiency of the turbine. From the formulae of the characteristic is evident that the same is independent of the diameter and of the size of the turbine. This is not exactly true but is near enough for any practical case. It should also be pointed out that the characteristic is independent of the head under which the turbine operates. If a turbine works on a different head, the number of revolutions is also changed and at the same time the total output, so that kN always remains constant. In the following table is given a series of characteristics for Francis turbines, and underneath each characteristic the corresponding efficiency appears. The first named corresponds to only one guide wheel and one runner. The last named are average values which can be regarded as possible to reach in good installation. Many times values can be found in the literature which are still higher than those given.

kN =	350	325	300	275	250	225	200	175	150	125	100	75	50
Efficiency =	75	76	77	78	79	80	81	82	83	84	84	82	80%

A high characteristic 350 to 250 is the evidence of high speed runners. A low characteristic 75 to 50 is evidence of low speed runners. As is seen from the table the highest efficiency is reached by using the middle characteristic, therefore the choice of output and number of revolutions for each unit should be so, that this middle characteristic can be used. By very low head the turbine would in this case run too slow and be too large and expensive, while with very high heads it would run too fast. In the first case one is compelled to use the high speed runner or use more guiding wheels and runners on one shaft. In the second case one must use the slow running Francis turbine or perhaps use the Impulse wheel. The placing of more guiding wheels and runners on a common shaft is the best method to increase the number of revolutions per minute and thereby get a higher efficiency as well by full as by partial gate opening. Should, for instance, a generator that makes 175 revolutions per minute and takes 1000 horsepower be driven from a turbine under an effective head of two meters, so is the characteristic,

$$k N = \frac{175}{12} \sqrt{\frac{1000}{\sqrt{12}}} = 250$$

If the turbine is only provided with one guide wheel and one runner, then is seen, from table above, that for such turbines the efficiency would be about 79 per cent. If this should be thought to be too little, or if higher efficiency with partial gate opening is wanted, it would be best to use a twin turbine. In this case we have only one-half the power on each wheel. The corresponding characteristic would be as follows:

$$k N = \frac{175}{12} \sqrt{\frac{500}{\sqrt{12}}} = \frac{250}{\sqrt{2}} = 175$$

corresponding to an efficiency of 82 per cent. If the number of runners are still further multiplied we get three or four ply turbines. A turbine with three runners has the following characteristic:

$$\frac{250}{\sqrt{3}} = 150$$

while the turbine with four runners has the characteristic:

$$\frac{250}{\sqrt{4}} = 125$$

In the last case the runners should be so constructed that one or more could be cut out during low water season, using the water at hand to the best efficiency in the remaining wheels.

The efficiency of an Impulse turbine changes with the dimension of the unit in the same way as does the efficiency for a Francis turbine, so that the characteristic also in this case gives information about the efficiency. The table below can be used as a guide:

kN =	20	17.5	15	12.5	10	7.5	5	(Approx. 2% low for American designs.)
Efficiency =	75	76	77	78	79	80	81%	

This characteristic corresponds to only one nozzle and the efficiencies are average values which in good installation can be regarded as possible to reach. In the same way as on the Francis turbine more nozzles can be put on one runner or more wheels can be put on the same shaft. In this way we can reach a given number of revolutions per minute at any desired efficiency or a higher efficiency can be reached at any speed.[2]

Should, for instance, 400 horsepower be given off at an efficiency of at least 77 per cent with an effective head of 75 meters, the turbine could be designed in the following way: From the table is seen that the tur-

[1] Translated by L. R. Jorgensen from Electrotechnische Zeitschrift, October 19, 1905.

[2] Not possible in American designs.

bine must have a characteristic of about 15. The number of revolutions per minute is then,

$$n = k\,N \times H \times \sqrt{\frac{V\,H}{N}} = 15 \times 75 \sqrt{\frac{V\,75}{400}} = 166$$

This seems too low, therefore two nozzles on one wheel is chosen. Each gives off 200 horsepower and the corresponding speed is calculated as follows:

$$166\sqrt{2} = 235$$

with four nozzles on two wheels the corresponding speed is given

$$166\sqrt{4} = 332$$

and with six nozzles on three or only two runners, the speed is

$$166\sqrt{6} = 400$$

Because N is equal in all these cases the turbines will practically have the same efficiency, 77 per cent, also their dimensions and speed varies considerably.

TUNGSTEN VS. OTHER FORMS OF STREET LIGHTING.[1]

BY E. L. SHERWOOD.

The customary practice in electric street lighting is in the use of the series constant current system, on account of the lower cost of line construction and lesser loss in distribution. Heretofore two series systems were found necessary, one for arc lamp circuits

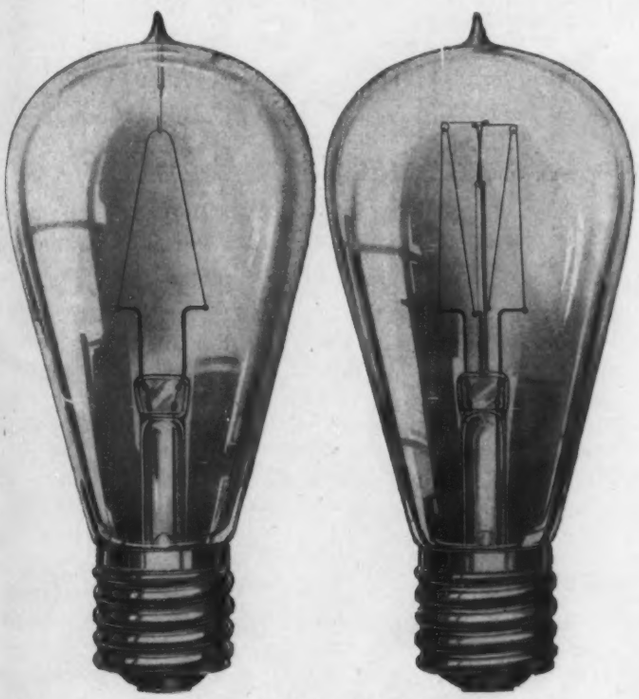


Fig. 1. Tungsten Lamps for Series Lighting.

requiring 6.6, 7.5 or 9.6 amperes, and the other for incandescent lamp circuits (Carbon or Gem) of lower current values such as 1.75, 3, 3.5 or 5.5 amperes. This was necessitated on account of the short life and higher cost of high ampere incandescent lamps, but when the tungsten series lamp was developed it was found that the high ampere lamps were just as good as the low ampere, in fact they are a little more rugged. This gives the tungsten an important advantage over the carbon or gem lamps, as now, should an incandescent lamp be desired at any point, it can be looped in on the arc circuit, and give perfect satisfaction.

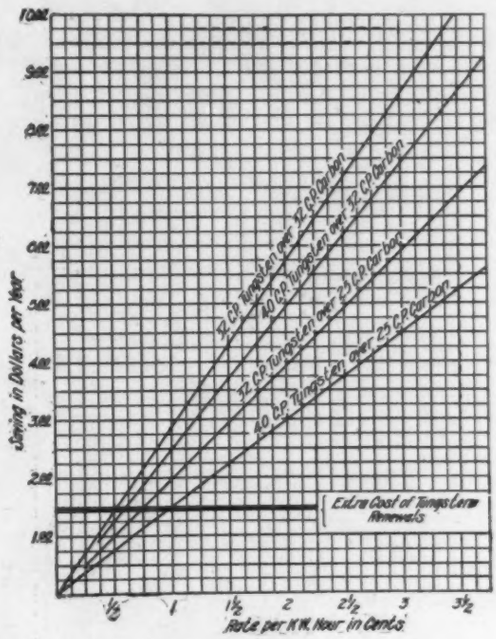

Saving in Dollars per Year
32 C.P. Tungsten over 32 C.P. Carbon
40 C.P. Tungsten over 32 C.P. Carbon
32 C.P. Tungsten over 25 C.P. Carbon
40 C.P. Tungsten over 25 C.P. Carbon
Extra Cost of Tungsten Lamp Renewals
Rate per K.W. Hour in Cents

Fig. 2. Annual Saving Tungsten Series Lamps vs. Carbon Series Lamps.

Another point in favor of the tungsten lamp is in its extremely long life giving in service from 1500 to 2000 hours on an average, and with practically no depreciation in candlepower. This not only means

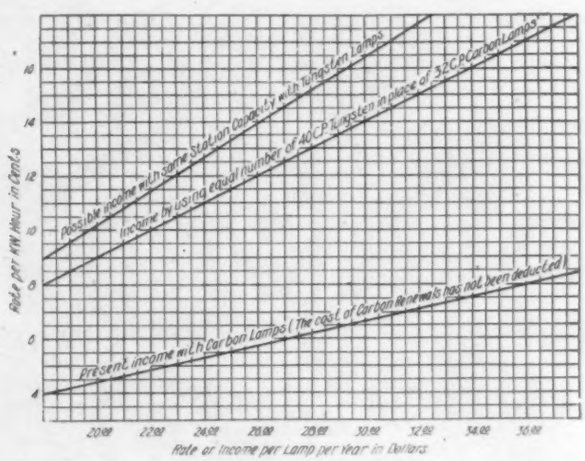

Possible income with same Station Capacity with Tungsten Lamps
Income by using equal number of 40 C.P. Tungsten in place of 32 C.P. Carbon Lamps
Present income with Carbon Lamps (The cost of Carbon Renewals has not been deducted)
Rate per K.W. Hour in Cents
Rate of Income per Lamp per Year in Dollars

Fig. 3. Gain in Income Tungsten vs. Carbon Series Lamp.

that a lamp requires trimming but two or three times a year with the consequent saving in labor of trimming and patrolling, but the lamp can be depended on to give a brilliant light until it fails.

As is probably well known, the tungsten lamp has the extremely high efficiency of 1¼ watts per candle, being twice the efficiency of the Gem lamp and about three times the efficiency of the carbon incandescent lamp. On account of its high efficiency and low labor cost of trimming, a large number of central stations,

[1]Paper read at May meeting Los Angeles Section American Institute of Electrical Engineers.

notably those in New England, have been replacing their arcs with clusters of tungsten lamps, or by more frequently spaced individual tungsten lamps, thereby obtaining a better distribution of light, and at a lesser cost.

In reviewing the sales of incandescent street lamps for the past year, it is interesting to note that not only have the total sales of all the manufacturers more than doubled, but about eighty-five per cent of the lamps sold were tungsten. The former is probably due to the stimulus given to street lighting by the introduction of the tungsten lamp, and the latter undoubtedly due to the tremendous saving made by the cental station in the tungsten lamp.

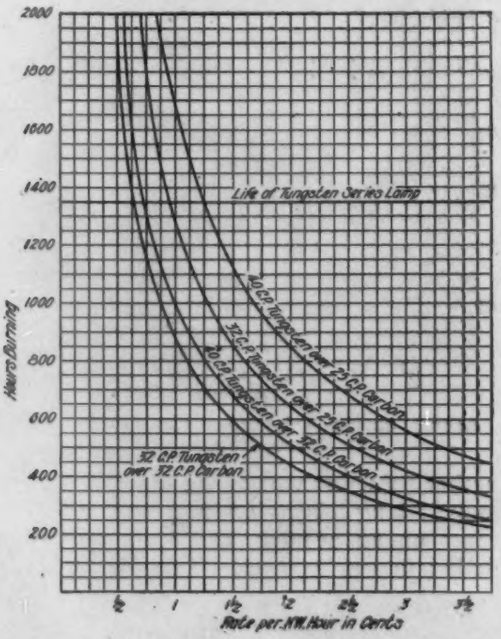


Fig. 4. Life Necessary to Compensate for Increased First Cost of Tungsten Over Carbon Series Lamps.

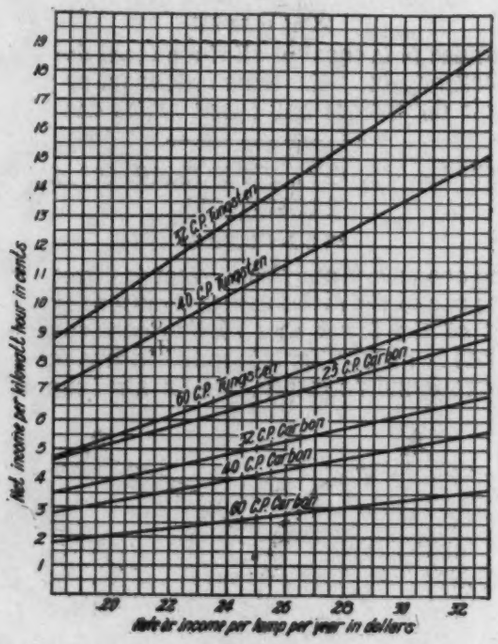

32 C.P. Tungsten
40 C.P. Tungsten
60 C.P. Tungsten
25 C.P. Carbon
32 C.P. Carbon
40 C.P. Carbon
60 C.P. Carbon
Net income per kilowatt hour in cents
20 22 24 26 28 30 32
Rate per income per lamp per year in dollars

Fig. 5. Net Income per Kilowatt Hour, Tungsten and Carbon Series Lamps.

In order to show the foregoing statements, let us look at Fig. 2, which shows the gross saving in 4000 hours yearly service (all night every night) of tungsten over carbon lamps. The basis of the figuring is that the renewals of lamps per year are four (a low average) for the carbon lamp, and three (a high average) for the tungsten lamp. The costs of the lamps are based on standard package quantities only, and hence central stations purchasing $175 or more net value of all lamps will obtain a lower cost of renewal. By referring to the curve it will be seen that at 1½c per kilowatt hour, the usual cost of current, the yearly gross saving for 32 candle-power lamp is $4.32. The extra cost of renewals per year is $1.85 for the tungsten, so that the net saving is the difference, or about $2.50 per lamp per year.

In addition to this annual saving, the station apparatus (constant current transformers, etc.) has about three times the capacity in number of lamps, so that for the same investment in the station, three times the revenue can be obtained by getting contracts for the extra number of lamps possible, which usually can be done on account of the better service given. If this is not possible, a still greater saving can be made where several transformers are used, by bunching several circuits on one transformer, thereby cutting out the core losses of the transformers not used, and using them as spare transformers in case of a breakdown. Often it can be arranged to have a full load on one or more transformers, instead of a partial load on several transformers, thereby increasing the power factor as a whole. In new installations, not only is there a lesser amount of energy required per lamp, but a lesser investment cost is required.

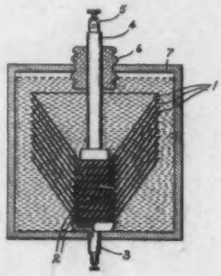
By a similar process of reasoning it can easily be figured out just how long a tungsten lamp must last to exactly save its increased cost of renewal. The curves in figure 4 are based on the same figures as before, and it will be seen therefore that at a cost of 1½c per k. w. h., the tungsten lamp must last 600 hours to break even. Should it last any longer, every hour represents a saving.

In competition with the gas or gasoline mantle lamp, the usual cost per lamp year for the mantle lamp varies from $25 to $30. From the curves in figure 6 which are based on 4000 hours yearly service, it is seen that the net income for current, after the cost of all lamp renewals has been deducted is from 4¼c to 5c per k. w. h. with the 40 c. p. carbon lamp, and from 10¾c to 13½c per k. w. h. with the 40 c. p. tungsten lamp. These rates for the tungsten lamp should certainly show a profit to the central station, considering the character of the service. Even with the 60 c. p. lamp which certainly gives much better service than the mantle lamp, the net income is from 2 2-3c to 3 1-3c per k. w. h. with the carbon and 7¼c to 9c per k. w. h. with the tungsten lamp.

Street Railway Men's Day at the A. Y. P. Exposition at Seattle will be June 28. The Seattle Electric Company will arrange its schedules so that all its employes can visit the fair on that day.

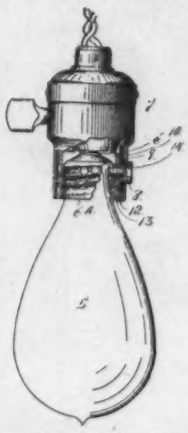
PATENTS

923,774. Electrolytic Cell or Condenser. Elmer E. F. Creighton, Schenectady, N. Y., to General Electric Company.



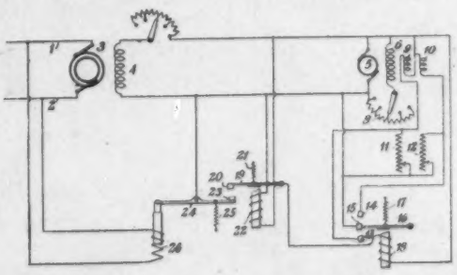
An electrolytic condenser comprising a plurality of oxidizable cups separated by an electrolyte containing citric acid.

923,284. Socket-Lock for Incandescent Lamps. Abbott L. Lowe, Denver, Colo. The combination with an incandescent lamp and socket or holder, of an insulating flanged sleeve inserted in an opening formed in the side, said sleeve having a



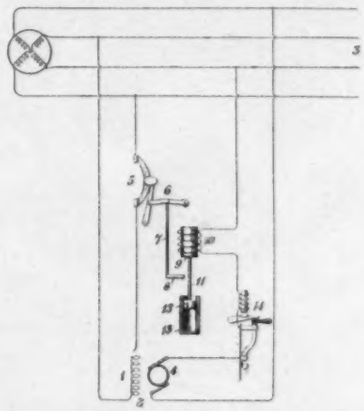
lug engaging the recess formed in the shell of the socket to prevent the rotation of the sleeve, an inner sleeve mounted in the insulating sleeve having a central interiorly threaded portion, a locking pin threaded in the latter and adapted to enter an opening formed in the neck of the lamp for the purpose set forth.

923,627. Voltage-Regulator. Frank Conrad, Swissvale, Pa., assignor to Westinghouse Electric and Manufacturing Company. The combination with an electrical circuit, and a dynamo-electric machine connected thereto, of an exciter



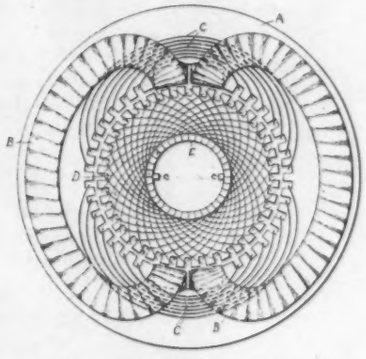
generator having a main field magnet winding and two auxiliary field magnet windings arranged to act in opposition, resistances in circuit with the respective auxiliary field magnet windings and means responsive in operation to variations in the voltage of said circuit for shunting the one or the other of the resistances.

923,666. Protective Device for Commutator-Type Alternating-Current Motors. Benjamin G. Lamme, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. The combination with a commutator-type motor having armature and field magnet windings separately supplied



with alternating currents, of an interrupter in the field magnet circuit, a tripping device therefor that is retained in inactive relation by the armature current, and means for delaying the action of the tripping device until a predetermined interval of time has elapsed after the opening of the armature circuit.

923,311. Electric Motor. Ernst F. W. Alexanderson, Schenectady, N. Y., assignor to General Electric Company. In a dynamo-electric machine, a field magnet having polar projections, main field coils carried in the interpolar spaces, a



compensating winding distributed on the pole faces, an armature provided with a commutator, and armature coils having a fractional pitch equal to the breadth of the pole faces.

918,660. Intercommunicating Trunking System. Elmer R. Corwin, Chicago, Ill., assignor to Corwin Telephone Manufacturing Company, Chicago, Ill. An intercommunicating telephone system having a plurality of local lines common to a plurality of stations, a trunk line extending from the intercommunicating system to a magnetic exchange, a repeating coil inductively connecting one of the said local lines with the trunk line whereby conversation may be carried on from the various said stations over the trunk line, a kick-coil having one winding bridged across the trunk line at the intercommunicating system, and means at the various said stations for causing the kick-coil to throw a drop on the trunk line at the magneto exchange.

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Comparisons

It is difficult to find an article in the technical press which does not contain some comparison of different ways of doing the same thing. Such comparison may be either direct or implied. It is sometimes obvious and sometimes veiled. The advantages of one method are listed against those of another and evidence is presented as to why the one should be adopted. The intent is to show that certain apparatus is better than any other. These articles are usually written by unbiased engineers incorporating the results of their personal experience. But "what is one man's meat is another's poison," and what is one man's success may prove to be another's failure. No method should be adopted or discarded on the dictum of one observer, for we are all liable to err. It is only from a consensus of competent opinion that fair judgment can be given. A method which is acceptable to a theorist may be of little value in practice, whereas the practical "rule of thumb" may prove cumbersome and unsatisfactory for scientific work.

A good machine in poor hands or under adverse conditions may make a poor showing as compared with a less efficient one properly run. This has been demonstrated many times in tests of steam turbines and reciprocating engines. Requirements may differ so that what is good under one set of conditions is of no value under another. An impulse water-wheel would offer little competition to a gas engine in the Sahara desert, and one match would be worth more than a carload of electric cigar-lighters at the South Pole.

Furthermore, it is possible for a method to be at once the best and the worst. An example of such dualty was afforded recently in an advertising competition in which the same copy was entered by two people, one of whom considered it the best and the other classifying it as the worst. Both opinions were accompanied by good evidence to support their contentions and both were right—from their own viewpoint. The most brilliant diamond is lusterless in some lights and from certain angles the imitation may rival the genuine.

These examples all show how unstable is the sensitive balance which determines the superior and the inferior. It sways with the slightest change in external conditions, its counterpoise is unprotected and parallax causes many a mistake. Even the equilibrium established by time is liable to change at any moment when some new method, perhaps once condemned, takes the place of the old, tried and true though it be.

CURRENT COMMENT

Attendance at the N. E. L. A. convention last week totalled 2,030 out of a membership of 3,215.

The resistance of shellacked coils varies with changes in atmosphereic humidity according to tests of the British National Physical Laboratory.

The cost of electric pumping at Cripple Creek, Colorado, is estimated to be half of that of pumping with steam. A low rate is offered for off-peak use.

The wireless telegraph is to replace the U. S. Government telegraph lines in Alaska which have been kept in repair by the signal corps with difficulty.

Oil tempering baths with electric heat and temperature control up to 600 degrees are being used with the new fused salt type of electric furnace for heating steel.

Stealing electricity in Colorado is punishable by a fine of from $50 to $300 and imprisonment of from 30 to 90 days. Proof of wire connection or injury to the meter is taken as evidence of guilt.

The longest telephone span is claimed to be that crossing Lake Wallenstadt in Switzerland. It is supported by two steel towers 7827 feet apart and at its lowest point is 130 feet above the level of the lake.

The production of mica in the United States during 1908 was worth $267,925, according to the U. S. Geological Survey figures. There were nearly one million pounds of sheet mica and 2417 tons of scrap.

The Northwest Electric Light and Power Association invites all electrical men to make their headquarters at the association's booth in Machinery Hall at the Alaska-Yukon-Pacific Exposition at Seattle this summer.

A strike on St. Petersburg electric railways was started on June 14 when all employes walked out following a refusal for an increase in pay and new arrangement of shifts. The strike is said to have been arranged by the Social Democrats to test their strength.

An electric dynamite thawer is in successful use at the Roosevelt drainage tunnel in Colorado. The powder house is equipped with large electric heaters which raise the temperature of the room to 80 degrees in half an hour at a cost of ten cents daily for electric current.

High tension damage to telegraph lines belonging to the Western Union Company caused them to ask for an injunction against the Chicago, Lake Shore & South Bend Traction Company's operating a high-tension trolley system. This injunction has been denied by the Superior Court of Indiana.

Power site withdrawals aggregating 233,365 acres of public land in Utah, Colorado, Wyoming, Montana, Idaho and Oregon have been approved by Secretary Ballinger in accordance with recommendations made by the U. S. Geological Survey, since April 23d of this year. These withdrawals are temporary, "in aid of proposed legislation affecting the disposal of water-power sites on the public domain."

An electric heating unit adopted for experiments at the British National Physical Laboratory consists of a thin strip of resistance wire wound on a thin sheet of mica, the electrodes of copper strip being threaded into the mica and soldered to the resistance strip. A thin sheet of mica is laid on each side and sewed round the edges, and the whole is slipped into a thin copper envelope, which is let into and soldered to the lower side of the bath. The unit can be easily removed for renewal or repair without moving or emptying the bath.

Electro-chemical theory of rust is discussed in Bulletin No. 35 of the Department of Agriculture by Allerton S. Cushman. Steel corrosion is said to be the result of electro-chemical action. As priming coatings for preventing rust zinc, barium and lead chromates made the best showing, while lampblack and graphite seemed to stimulate rather than inhibit rust. Varnish and bitumens showed up well. The author believes that concrete prevents corrosion because it contains free lime, and if this is washed out rusting becomes probable. Steel pipe immersed in soggy, sour clays can have its life prolonged by the addition to the clay of 5 per cent of quicklime. Homogeneous steel will resist rust without a protective coating.

Destruction of telephone poles by insects is generally underestimated, as their depredations go on gradually, but forcibly, attracting little observation. When they bore into the timber they open up air chambers and channels which make it easy for rainwater to seep in, and thus keep the wood in a moist condition. Fungus spores floating through the air are enabled to germinate with greater rapidity and with increased effectiveness and the decomposition of the pole consequently is materially hastened. Several years ago the Forest Service co-operated with one of the large telephone companies in Georgia and Florida to experiment with various preservatives in protecting the butts of telephone poles from decay. These preservatives were simply painted upon the wood, and of course did not sink in to any great depth. A recent examination made of this pole line showed that wherever the preservative had entered the wood no destruction due to insect attack had taken place, but where the wood was unprotected, such injury was frequently quite serious. Poles in which the preservatives had seeped through a crack were often more or less fluted on the surface, that is, the oil saturating the wood in the immediate vicinity of the crack protected it from the attacks of the insects. It is essential, therefore, particularly in the warmer portions of the United States, to protect timber from the attacks of insects as well as of fungi, if the longest life is to be secured.

PERSONAL.

W. H. Little, of Woodin & Little, San Francisco, is in the Yosemite Valley.

H. E. Lamar of the Golden West Plating Works, San Francisco, is traveling in Mexico.

H. J. White, manager Keeler, White & Co., manufacturers' agents, 824 Folsom street, San Francisco, is in Los Angeles.

Converse J. Smith, President Standard Gas Engine Company, Oakland, California, is making a trip through the Northwest.

H. L. Crocker and M. L. Ketchum have opened offices as consulting civil engineers at 811 Seventeenth Street, Denver, Colo.

C. G. DuBois, comptroller of the American Telephone & Telegraph Company of Boston, is expected in San Francisco about July 1st.

Wm. H. Hall, consulting engineer, Postal Telegraph Building, San Francisco, left for New York this week on professional business.

W. I. Otis of Otis & Squires, San Francisco, will return next week from an extended trip of several weeks through Southern California.

S. T. Johnson, contracting engineer and manufacturer of oil-burning apparatus, 1334 Mission street, San Francisco, is in Honolulu and will return in about two months.

C. E. Glafke, of the Glafke Manufacturing Company, 451 Minna street, manufacturers of valves and pump governors, was among the California boosters at Seattle this week.

C. C. Hillis of the Electric Appliance Company of San Francisco has been in the East for the past three or four weeks and is expected back shortly after the first of July.

L. E. Sperry, former manager of the California Electrical Works and Western Electric Company at San Francisco, is now manager of the Omaha house of the Western Electric Company.

Frank W. Frueauff, vice-president and general manager of the Denver Consolidated Electric Company of Denver, Colorado. has been elected president of the National Electric Light Association.

John H. Dale of the Dale Company, New York, who has been seriously ill with pneumonia, has so far recovered that he is able to leave for a short trip to the seashore, where he is now recuperating.

J. F. Hetty, of Hetty Bros., San Francisco, who left on a trip abroad in April, was last heard from at Monte Carlo. His present plans are to reach San Francisco again on about the first of September.

A. S. McAllister, associate editor of the "Electrical World," New York City, is making a study of Western transmission practice. He was in San Francisco last week and is now visiting the Northwest.

James Campbell, well known in San Francisco in connection with electrical construction work is planning a trip of two years abroad. Arrangements made provide for his departure during May of next year.

W. S. Heger, assistant to the president of the Allis-Chalmers Company, who has spent the past three months on the Pacific Coast, returned to Milwaukee, Wis., on June 12th, accompanied by R. B. Elder of the San Francisco office.

D. F. Peterson, traveling auditor with the American Telephone & Telegraph Company of Boston, formerly connected with the Western Electric Company in the same capacity, is now in San Francisco and will spend several weeks in this territory.

H. C. Thaxter, sales engineer with the San Francisco office of the Allis-Chalmers Company, has returned from an Eastern trip of a month which included some time spent at the West Allis, Wisconsin, works of the company, familiarizing himself with details of manufacture.

G. B. McLean recently associated with the San Francisco office of Chas. C. Moore & Company, joined the San Francisco force of the Allis-Chalmers Company under date of June 15th as sales engineer. Mr. McLean brings with him a wide experience which includes four years of engineering work in Southern California with R. S. Masson of Los Angeles.

Richard W. Boren, who for a year and a half has been the expert ad compositor and trade-paper man on the instruction staff of the International Correspondence School of Advertising, at Scranton, has been engaged by the General Electric Company for special advertising work. It is understood that the General Electric Company will undertake some advertising on behalf of such specialties as electric irons, cigar lighters, etc.

TRADE CATALOGUES.

J. M. Regal Roofing and Keystone Hair Insulator, two articles of use to constructing engineers, are described in leaflets issued by H. W. Johns-Manville Co.

Archbold-Brady Co., engineers and contractors, Syracuse, New York, send a number of excellent half-tone illustrations of catenary railway and high voltage contsruction of their design.

An International Achievement is the subject of an illustrated pamphlet from the Western Electric Company, describing the rapid reconstruction of the Paris telephone system destroyed by fire last year.

Gasoline driven locomotives for service manufacturing plants, mills, lumber yards and camps, mines, plantations, quarries, railroad, electric railway, tunnel and canal construction and general freight and passenger transportation are attractively portrayed in Publication No. 100 from the Milwaukee Locomotive Manufacturing Co., Milwaukee, Wis.

The American Electrical Heater Company, Detroit, Mich., is drawing attention to the "American" instrument sterilizer in a handsomely printed brochure to the trade. The sterilizer is made entirely of aluminum. The body is cast in one piece, consequently there are no seams to come apart. There is no danger of leaking, in fact, trouble of any kind. Not only this, but the aluminum retains its finish and is always sanitary, clean and neat in appearance. Most sterilizers are flimsily constructed of sheet metal with soldered seams. It is equipped complete with aluminum instrument tray, cover, etc.; made for three different heats, the maximum to heat the water quickly, the minimum—one-fourth of the maximum—being sufficient to keep the water boiling.

PORTLAND SECTION, A. I. E. E.

At a meeting held in the Sherlock Building, June 1st, the organization of a Portland Section of the American Institute of Electrical Engineers was effected and the following officers were elected for the ensuing year: Chairman, O. B. Coldwell; Secretary-Treasurer, L. B. Cramer; Executive Committee, W. Spalding, L. M. Antoine and L. Quimby. After the business meeting a smoker was held. Entertainment was provided and refreshments were served. The evening was much enjoyed by all. The attendance was thirty-five.

INDUSTRIAL

NEW POLICE COMMUNICATING SYSTEM.

Absolute municipal police protection is economically provided by the patrol flashlight system. The complete outfit provides absolutely reliable means of instantly reaching any patrolman on duty, as well as the equipment for communicating with headquarters from any patrol district. Separate apparatus furnishes a modern fire alarm system as well as instant means for calling a patrol wagon, and a device for registering the officers' report calls on a tape at police headquarters. The system is by no means in the experimental state, since a complete installation has been in successful operation in North Tonowanda, N. Y., for the past two years.

Fig. 1. Closed Patrol Box.

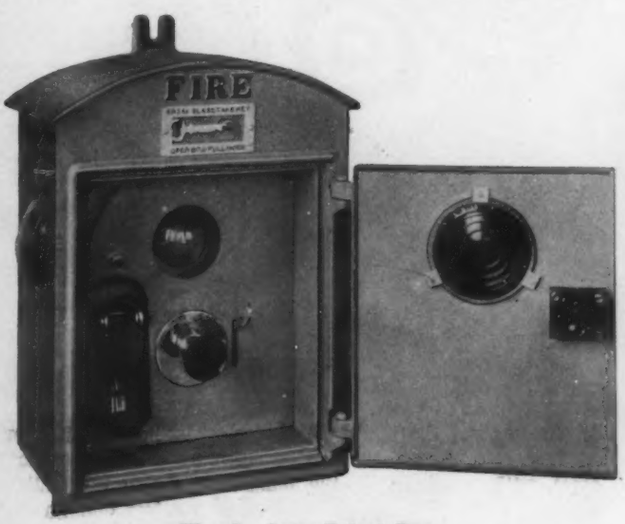

Fig. 2. Open Patrol Box.

This outfit was installed by R. Max Eaton, the general manager of the Niagara Home Telephone Company.

The distinctive feature of the flashlight system is the addition of three powerful red lenses in the patrol boxes. A brilliant incandescent lamp may be lighted behind these lenses by the operation of a very simple connective device at police headquarters. The lights are visible from three directions for at least 500 yards in the day time and for miles at night. Heretofore, there has been no system to call the patrolmen, from headquarters, unless the officer happened to be near enough to her his bell ringing.

In installation, patrol boxes are so located on each district that at least one light is always within the line of vision of the officer on that beat. If headquarters desires to reach any patrolman, all of the lamps in his district may be lighted to advise him to come to the telephone. The telephone part of the equipment is perfect. By connection through the most modern multiple circuits, all possibilities of noisy lines or other interruptions are completely removed. An interesting test in demonstrating the apparatus is to show that the tick of an ordinary watch is readily heard over the lines.

The flashlight patrol box also provides instantaneous fire alarm facilities, which may be included in the initial installation or readily added at a later time. The apparatus is so simple in construction that this change may be made in a very few minutes by the addition of a few small parts. Turning in an alarm automatically lights a lamp calling the patrolman in that district. This stays lighted until the fire chief replaces the glass which has been broken to obtain the key. Police headquarters as well as the fire department are notified automatically.

The illustrations show the details of the patrol box. Fig. 1 shows the general appearance of the closed box as it would be mounted. Fig. 2 shows that portion of the box that is exposed in making a report to headquarters or in turning in a fire alarm. The hook on the right has a dual purpose in providing facilities for police regulation and for the ordinary fire alarm purposes. The Dean indestructible transmitter and receiver are shown in this illustration, as well as a small button immediately above the receiver. This button is used for calling the patrol wagon.

Fig. 3. Illustrates the inner mechanism exposed by opening the second door. The position of the lamp, lightning arrester, line terminal posts, etc., are very clearly shown. All of the apparatus is very readily accessible and all contacts are plainly exposed for examination.

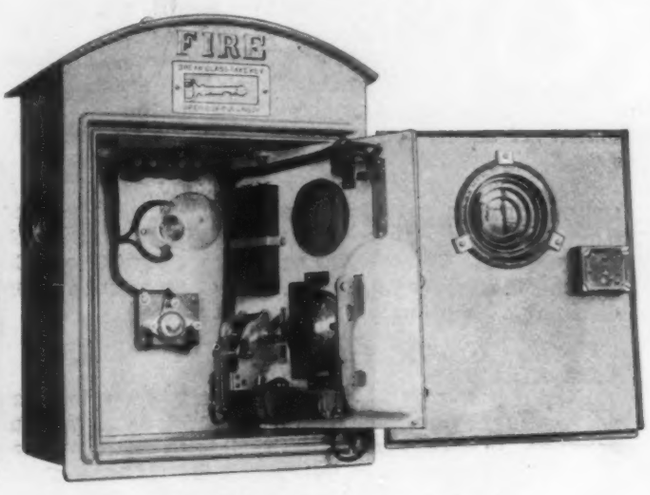

Fig. 3. Inner Mechanism of Box.

The entire outfit is moisture proof, and by the use of special prepared wire, difficulties from this source are eliminated. To prevent even the slightest interruption of service, the standard Dean indestructible parts are used almost exclusively. Very little special apparatus is required. Hence, operating

companies may maintain a patrol flashlight system without encountering the necessity of carrying an additional line of spare parts.

The economic saving of this method is evident, since the telephone company already has cables all over the city. Their trained technical men build and maintain the system in satisfactory operation at a much less cost than the city could handle the work. The saving in outside construction alone is enormous.

RAILROAD MEN AT A. Y. P. EXPOSITION.

Chas. S. Fee, passenger traffic manager of the Southern Pacific Company, has telegraphed that twenty Southern Pacific passenger agents from all parts of the Pacific System visited the Alaska-Yukon-Pacific Exposition on June 9 and were unanimous in their praises of all that they saw. It's a wonder, unique among all similar expositions. It tells a big story to people of all this nation, a true story of what there is to be found today in Alaska and the great Northwest. Every building was ready on the opening day and flags flying and bands playing just as they will continue until the closing October 15th. The exposition as it stands represents an investment of about ten million dollars. The Forestry Building, made of monster timber from the forests of Washington, is the most remarkable of all buildings, while the Alaska exhibit tells in detail of the country that has yielded two hundred and ninety-six million dollars worth of products in the past thirty years. The buildings and grounds are remarkably well arranged, so that one can get about easily without weariness and all details most artistic in conception.

SAN FRANCISCO AUXILIARY FIRE FIGHTING SYSTEM.

Considerable interest has been manifested in the auxiliary fire system that is now being constructed in San Francisco and while at this time there is not sufficient data available for a complete report covering the behavior of these pumps during tests, it can be stated that the first part of the contract that the Byron Jackson Iron Works had with the City of San Francisco is complete, the pumps having been delivered and accepted and the workmanship, guarantee of economy, pressure and capacity up to the expectations of the engineers. The contract consists of four units of 600 h. p. each, driven by Curtis steam turbines, these units having a capacity of 2250 gallons per minute, against a pressure of 300 pounds, and so arranged that by a manipulation of valves a capacity of 4500 gallons per minute may be obtained under a reduced pressure of 150 pounds.

The second part of the contract consists of eight four-stage station pumps, to be placed in two pumping stations that are now being designed, and which are to be located near the waterfront. These pumps each have a capacity of 2700 gallons per minute against a pressure of 300 pounds, being driven by 750 h. p. Curtis steam turbines.

NELSON CRUDE OIL BURNER.

The Nelson crude oil burner is the only burner that does not require an oil pump or other auxiliaries for its successful operation. In the Nelson system the oil is not under pressure and when the burner is not in operation the oil in the system automatically returns to the oil storage tank. The oil passages through the burner are large and free from obstructions, therefore the burner will not clog or fill with carbon, and the Nelson burner is guaranteed to more thoroughly atomize the oil passing through the burner than is possible with any burner using baffles, small openings or screens for atomizing purposes.

The burner has no inside working parts and there is nothing about the system will need attention or repairs after being installed. It is handled by Beggs & Wold Company, 507 Mission street, San Francisco.

LOW PRESSURE TURBINE IN THE LUMBER INDUSTRY.

That the economies possible in the use of low pressure turbines are not confined to the highly efficient power plants of the East, is apparent in the contract recently placed by the Potlatch Lumber Company for a 600 kilowatt Westinghouse exhaust steam turbine to be installed in the company's central power plant at Potlatch, Idaho. There are at present located in this plant one rope-driven Corliss engine and a 100 kilowatt high-speed triple engine driving a generator. The low pressure turbine will take steam at about 15 pounds absolute from both of these units, and some other auxiliaries generating power for the operation of a new planing mill and box factory. Arrangements have also been made for the operation of this unit for lighting for the mill and the surrounding town. The equipment ordered also includes a Westinghouse Leblanc condenser designed for carrying a 28-inch vacuum. At the Potlatch plant, refuse from the sawmill is used entirely for fuel at practically no cost, this being burned under M. R. T. boilers.

It is thus apparent that the capacity of the plant has been very greatly increased with practically no cost except the charges on the low pressure turbine installation. This feature of exhaust turbine work, is being rapidly appreciated by managers of power plants in every line of industry, resulting in a number of orders for equipments of this character. Just recently the Westinghouse Company has installed low pressure turbine equipments in the plant of the Pressed Steel Car Company, Pittsburg, and the American Iron & Steel Company, Lebanon, Pa.

BENJAMIN WEATHERPROOF TUNGSTEN ARC.

The "Benjamin Weatherproof Tungsten Arc Lamp," manufactured by the Benjamin Eelectric Manufacturing Company, Chicago, Ill., is a good-appearing and efficient substitute for arc lamps. It has a twenty-inch high-grade porcelain-enameled steel reflector and a twelve-inch glass ball. Above the former is the body portion of copper, a metal cross-arm with porcelain knobs, a weatherproof porcelain connecting block, and a suspension loop. The globe may be suspended and held in position for cleaning and removing the lamps, or may be entirely removed, if desired. This is accomplished by means of a rod passing through the hollow support. It is ventilated

at the top and the bottom by holes which are small enough to keep out insects. An inside reflector of white enameled steel, with openings for the lamps, assists in the radiation of light. This and the main reflector are low enough to secure a good distribution of the horizontal rays in a downward direction. The device may be furnished without the upper portion when attached to a gooseneck or other form of suspension where the wires are concealed. It is made with four and five lights and is suitable for lamps with a maximum wattage of 100. The above illustration of the Benjamin Weatherproof Tungsten Arc shows the compactness of this fixture as compared with the usual arc lamp, which it greatly resembles in external appearance, except that it is much shorter.

THE MECHANICS FAIR.

The Mechanics' Fair, given under the auspices of the National Association of Stationary Engineers and in connection with the Sixth Annual Convention of the California section of that order was held during the present week at the Auditorium, San Francisco.

From every standpoint the Fair was an unqualified success; the attendance was large during the entire week, particularly during the evenings. The exhibit was a representative one, including machinery and accessories of every description, a large part of it being in actual operation. Attractive decorations and an unusually good band concert, afternoon and evening, developed a carnival spirit which was irresistible.

The various committees and managers who worked long and tirelessly to bring about this result are entitled to congratulations for the successful manner in which their plans were carried to completion; the numerous exhibitors also are entitled to great credit for the liberality shown in their displays and the enthusiasm with which they supplemented the work of the Association.

It was unfortunate that that feature of the program which called for the introduction of the National President, Fred J. Fischer, could not be carried out owing to his non-arrival at the expected time. When this point in the program was reached it was announced that Mr. Fischer was lost in the fog on the steamer Santa Rosa.

In the absence of the National President, State President Harry D. Saville made the address of welcome on behalf of the Association, outlining its objects, reviewing its past history and expressing its hopes for the future. After an impressive prayer by the Rev. Wm. Rader, P. L. Ennor, Chairman of the Convention Committee, introduced Mayor Edward R. Taylor, who, on behalf of the City of San Francisco, extended a warm welcome to the visiting engineers and in a few brief words commented on the science of steam engineering and the important position it occupies in industry.

At the conclusion of his remarks the button was pressed which gave the signal for the opening, the band played the Star Spangled Banner, bells rang, whistles blew, machinery roared, and, aided by the cheers of the spectators, the Mechanics' Fair of '09 was formally under way.

In view of the numerous exhibitors it is impossible for the Journal to include a complete description of the various exhibits in this issue and a description of a part is given below; the description of the balance, together with the complete proceedings of the Convention itself, will appear in our issue of June 26th.

Exhibit of General Electric Co.

Exhibit of Westinghouse Electric & Manufacturing Co.

The exhibit of the GENERAL ELECTRIC COMPANY, in booths 119, 120, 181 and 182 attracted a great deal of attention and was crowded with interested visitors during the entire week. It was planned by A. G. Jones and H. E. Duren of their San Francisco office who were assisted during the week by F. E. Vickers, A. Strauch, E. O. Shreve, J. S. Baker and G. E. Rutledge. A searchlight, flaming arc lamps and a mercury arc rectifier were in continual operation, and the exhibit also included fan motors, power motors of different types and some typical examples of their heating and cooking devices. A 35 k. w. 3600 r. p. m. non-condensing Curtis turbine attracted a great deal of attention.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, Second and Natoma Streets, San Francisco, occupied booths 116 and 117. The Westinghouse exhibit was a diversified and interesting one both for the electrician and layman. A complete line of electric irons, luminous radiators, hot plates and other heating devices, together with a motor-driven washing machine and a sewing machine interested the women, while a small steam engine operated by compressed air and a single phase motor operating an air compressor interested the mechanic. The exhibit was lighted by a large Westinghouse electric sign illuminated by a 27-volt, 10-watt tungsten lamps, the voltage being reduced by tungsten economy coils on the switchboard.

This exhibit was in charge of J. E. Collins, C. D. Herbert and J. G. de Remer.

THE WESTINGHOUSE AIR BRAKE COMPANY, Pacific Building, San Francisco, occupied booths 118 and 183 and was in charge of A. F. Peterson, manager of the San Francisco office. It included belted compressors, direct connected motor compressors, direct connected steam driven compressors and accessories.

Exhibit of Western Electric Co.

THE WESTERN ELECTRIC COMPANY was located in booths 136, 164. Their exhibit included a complete line of fan motors, forge blowers, arc lamps, Sunbeam tungsten lamps, Blue Bell dry batteries and a complete system of their most recent types of intercommunicating telephones in full operation. The exhibit was in charge of F. C. Todt and E. K. Dyer devoted some of his time during busy moments.

Exhibit of Fairbanks, Morse & Co.

FAIRBANKS, MORSE & CO., 158-162 First Street, San Francisco, occupied booths 198, 199, 200, 257, 256, 258, in charge of D. C. Martin C. F. Reuter, L. E. Penniman, P. F. Wood and E. V. Sheppard. Their exhibit was an elaborate one, the principal features consisting of duplex steam pumps, duplex power pumps electrically driven, alternating and direct current motors, and horizontal and marine gasoline engines.

Exhibit of Eccles & Smith Co.

In the central booth THE ECCLES & SMITH COMPANY exhibited Chicago pneumatic tools and air compressors, the manner of handling these tools and the work they will accomplish, was shown by the demonstrator. An artistic arrangement was made of Albany grease, mechanical rubber goods, Majestic boiler compound and engineroom supplies in general. Especial mention should be made of the Dean boiler tube cleaner. The manner in which it removed the scale from a fire tube during the demonstrations was noted particularly. The ladies fell in love with the Thor electric washing machine. The Eccles & Smith Company show this machine as an introduction to the public of a complete line of household appliances operated by electricity, which they will offer in the near future. The public generally is invited to the sample rooms, 71 First Street.

As to the care of tungsten lamps, the General Electric Company in one of their recent bulletins suggest that a wall switch, instead of one at the socket, will prevent jarring the filament when cold—its least durable state. When wiping or dusting the bulb, shade or fixture, the lamp should be burning.

Exhibit of Maryland Casualty Co.

THE MARYLAND CASUALTY COMPANY, whose home office is in Baltimore, Maryland, was represented during the entire week in an attractive booth in charge of C. M. Hansen, the inspector general of the company, assisted by W. B. Wentz and H. W. Wheatley. The object which this company had in co-operating with the Mechanics' Fair was to advise owners and operators regarding the details of their business, and particularly that their form of insurance furnishes educated and trained inspection service; also to advise how to avoid accidents. Literature distributed by them treated on the strength of rivets, science of inspection and other features of interest. In connection with their service they emphasized their claim that the basis of boiler insurance is intelligent inspection.

NEWS OF THE STATIONARY ENGINEERS.

San Francisco No. 1, N. A. S. E., held a smoker and housewarming at their new hall, 124 Fulton street, on the evening of June 10th.

The occasion was also given in honor of the sixty-first birthday of Bro. Conrad Witzel, the only remaining charter member of the organization.

Exhibit of the Crane Co.

CRANE CO.'S exhibit consisted of a display of valves and fittings ranging in size from ⅛-inch to 18-inch. A novel feature of their display was the 4-inch, 6-inch and 8-inch pipe bends made in elbow and U patterns in their San Francisco shops. Their all steel valves for superheated steam were also prominently displayed. The exhibit was in charge of Mr. Milton G. Moenning.

Exhibit of John Finn Metal Works.

JOHN FINN METAL WORKS of 384 Second Street, San Francisco, occupied booths 125 and 176 where they gave a complete exhibit of Babbitt metal, solder and galvanized work. For over twenty years this company has made its headquarters in San Francisco, manufacturing high grade Babbitt metal and solder for every purpose. This company manufactures twenty-four grades of Babbitt metal and it has always been their policy to educate the machinery and engine manufacturers in the proper grade of metal to use in order that the purchaser may secure the greatest advantage. This company maintains a force of experts who are always ready to furnish information pertaining to the grade of metal required for any service.

Exhibit of Bowers Rubber Works.

One of the most attractive features of the fair was the display of the BOWERS RUBBER WORKS, San Francisco. The exhibit gives a general idea of their line of rubber goods, all of which are manufactured in California. Their factory is the first and largest on the Pacific Coast importing crude India rubber and manufacturing it into all kinds of mechanical rubber goods such as belting, hose, packing, mats and molded goods. The exhibit was in charge of John M. Powell and H. R. Mansfield.

Exhibit of Staples & Pfeiffer.

STAPLES & PFIEFFER of 102 Steuart Street, San Francisco, were in booths 112 and 113 which were in charge of Messrs. Staples and Pfieffer, assisted by F. Hoffman. They exhibited the S. & P. self cleaning oil burners, self cleaning oil systems, self cleaning oil strainers, self cleaning relief valve. Their claims of being "up to date and a day ahead" and "no fuss—no worry—no delay—no trouble" attracted numerous engineers and their booth was crowded continually. They distributed many copies of their books on "Oil-Burners, and Oil-Burning Pointers."

EXPOSITION NOTES.

F. H. Doyle, 712 Market St., San Francisco, was the official photographer and furnished all pictures of exhibits.

The searchlight in the exhibit of the General Electric Company was in the hands of an operator with a keen appreciation of stage effects. It was turned on by His Honor Mayor Taylor at the critical moment when pushing the button which opened the fair and later illuminated the smiling face of National President Fischer during his introduction from the balcony.

NEWS NOTES

TELEPHONE AND TELEGRAPH.

BOTHELL, WASH.—The Independent Telephone Company will erect a building for a sub-station.

SAN FRANCISCO, CAL.—A new wireless plant is being installed in the Pacific Coast Company's liner President. A special room has been built on the after hurricane deck, in which the United Wireless Telegraph Company has placed a two-kilowatt plant to take the place of the former system.

SAN FRANCISCO, CAL.—With the idea of increasing the power of the wireless station on the Farallon Islands so that a conversation can be had at least 1,000 miles farther away than at the present time, a party headed by George Hanscom, master electrician of the Mare Island navy yard is at the islands. It is the idea of the navy department to rebuild entirely the wireless tower and to install a number of new instruments. This work is expected to require about one month to complete. When finished the tower will, it is asserted, have the highest power plant in the service of the government.

INCORPORATIONS.

FRESNO, CAL.—Waratah Oil Company; capital stock $300,000; by the above named as directors.

BAKERSFIELD, CAL.—Kern Four Oil Company; capital stock $100,000; by H. F. Brown, H. P. Taylor, L. R. Works, J. D. Works and A. M. Williams.

ANAHEIM, CAL.—Security Oil Syndicate; capital stock $240,000; by J. E. McDonald, H. P. Caotes, K. A. Snyder, J. B. Merrill, and I. L. Gates, all of Los Angeles.

CORNING, CAL.—Beacon Oil and Gas Company; capital stock $200,000; by Charles Hughes, C. L. Cofer, J. B. Reese and W. A. Fish of Red Bluff and H. M. Owens of San Francisco.

FRESNO, CAL.—Minoru Oil Company; capital stock $500,000; by A. L. Weil, M. Syme, Jessee Mueller and William E. Eckhoff of San Francisco and E. B. Davis of Oakland. Place of business, San Francisco.

SALT LAKE CITY, UTAH.—The Progressive Telephone Company of Lincoln, Tooele County, has filed articles of incorporation with the secretary of state. The Capital is $3500. The incorporators are ten residents of Lincoln. J. W. Whitehouse, president; Harriet W. Sagers, vice-president; Charles Hansen, secretary, and others.

BAKERSFIELD, CAL.—Articles of incorporation for the Producers' Transportation Company which will handle the oil of the independent producers of Kern County and Coalinga have been filed here. The company is capitalized for $7,000,000 and the directors are: L. P. St. Clair, S. W. Morshead, W. W. Welsh, M. V. McQuigg, Thomas O'Donnell, L. W. Andrews and W. B. Robb. Bakersfield is the principal place of business. The Union Oil Company is reported to be financing the corporation.

NEVADA CITY, CAL.—Articles of incorporation of the Middle Yuba Hidro-Electric Power Company have been filed here. The principal place of business is to be Nevada City and its capital stock is $400,000. The directors named are: A. D. Foote, C. M. Wilson, W. H. Martin, L. M. Hancock, L. N. Wagner, C. T. Jones and Dr. A. H. Tickell. They are all local people and will build an electric power plant on the Middle Yuba river above Graniteville to supply power to the mines of that district, Alleghany and other Nevada and Sierra county mining towns.

TRANSMISION.

HANFORD, WASH.—The Hanford Irrigation and Power Company has let a contract to the Allis-Chalmers Company for machinery for an electric sub-station and waterworks in Hanford. Electric current is to be brought down from Priest Rapids to Hanford to operate a pump with a capacity of 750,000 gallons a day.

WALLA WALLA, WASH.—Plans for a new $100,000 power plant and sub-station and for a $30,000 office building and depot has been announced by officers of the Northwest Corporation, the holding company for the local electric light company and the Walla Walla Valley Traction Company, work to commence at once.

YREKA, CAL.—Harvey J. Sarter and assistants have completed the survey of the Siskiyou Electric Light and Power Company's new power line from the Fall Creek power house as far as Sisson. Up to this point the route follows the township lines and is perfectly straight. Where the line passes Sisson a branch will be run west to the town. At the point of intersection the main line diverges to the east and will follow the county road into Dunsmuir. The survey, which is about 55 miles long, will be completed in a few weeks. It runs through the Big Springs country and will furnish power to pump water and irrigate thousands of acres of dry land. The company is extending the south end of the Fall Creek powerhouse to accommodate another 1000-k. w. generator. The new line will be equipped with heavy copper wire. The poles, wire and insulators are now at Ager, Montague, Weed and Sisson ready for distribution along the line. The construction crew will work south from Fall Creek, following up the surveying crew. The various lines of the company will be tied together as fast as completed in order that power may be pumped from one line to another in case of accident at any point.

FINANCIAL

MONROVIA, CAL.—This place has voted $16,500 in bonds for waterworks improvements.

HOOD RIVER, ORE.—An election will be held July 28 to vote on the question of issuing bonds in the sum of $90,000 for a municipal water system.

JACKSONVILLE, ORE.—The people of Jacksonville will this week vote upon a bond issue of $100,000 for the construction of water works for the city.

CENTRAL POINT, ORE.—The City Council has taken initial steps toward issuing bonds to the amount of $25,000 for the installation of waterworks.

HILTON, ORE.—The election held May 25 resulted in a large majority favoring the issuing of bonds to the amount of $15,000 for the extension of the city light and power plant.

ILLUMINATION.

FRIDAY HARBOR, WASH.—The Pacific Electric Company of Port Townsend, has applied to the city council for a fifty-year franchise to furnish electric lights for Friday Harbor.

SANTA ANA, CAL.—Application has been made to the Supervisors for a 25-year franchise for a transmission and distributing system for light, heat and power purposes. Sealed bids will be received by the Board of Supervisors up to July 7th.

KENDRICK, IDAHO.—A franchise has been granted to the Kendrick Gas Company to furnish gas to residents of the town.

PULLMAN, WASH.—The Trustees of the State College are considering $50,600 expenditure on the lighting and heating plant.

NATIONAL CITY, CAL.—The City Trustees are figuring on two separate schemes for increasing the efficiency of street lights in National City.

BELLINGHAM, WASH.—The Washington Mining & Development Company will spend $200,000 in erecting a power station on Collins Creek. W. N. Bath is director.

SAN DIEGO, CAL.—The City Council has awarded a contract for furnishing ornamental iron posts, eight in number, for Fifth street, from B to C, to the Standard Iron Works, their bid being $725.22.

SAN DIEGO, CAL.—The San Diego Consolidated Gas & Electric Company has increased its capital from $1,500,000 to $3,500,000; extensive improvements will be made to its plant. R. L. Clarke is superintendent.

SAN JOSE, CAL.—Sealed bids will be received by the Board of Supervisors up to July 12, 1909, for a franchise to construct underground conduits as applied for by the Los Gatos Ice, Gas & Electric Company.

LOMPOC, CAL.—The stockholders of the Lompoc Light and Power Company met this week and elected directors and transacted other business matters of importance. It was decided to replace the engine with one of double efficiency or about 150 horsepower. Mr. Heller was re-elected president; Mr. Baird, vice-president and T. F. Fox, treasurer.

OAKLAND, CAL.—Work began June 14th on the new plant of the Oakland Light and Power Company at the corner of First and Alice streets. The company is capitalized at $1,250,000. The new power plant will be equipped with machinery sufficient to generate 25,000 horsepower, and it is expected the new plant will be in operation by January 1st.

SAN FRANCISCO, CAL.—A new electric, gas and power company, organized by Rudolph and Claus A. Spreckels has been incorporated under the name of the Municipal Light and Power Company. It is capitalized at $1,000,000, of which $500 has been subscribed, $100 by each of the five directors, who are Rudolph Spreckels, Claus A. Spreckels, Percival S. Scales, J. H. Sandford and Frank Harrold, clerks in the Spreckels office. An electric light plant known as the Spreckels plant has been in operation for some time on Jesse street near Third street, and recently has been enlarged. It has been supplying light to several of the Spreckels buildings, also to the Phelan building on Market street, and to adjacent hotels, and it is believed that this plant is the basis for the formation of the new company.

IMPERIAL, CAL.—W. F. Holt, who has been spending the week in Imperial Valley, says El Centro and Imperial will have domestic gas service simultaneously. He has ordered ten carloads of service pipe, five for Imperial and five for El Centro, and these are to be shipped at once from Pittsburg. Contracts for the entire gas-making plant have been awarded, and the machinery will soon begin to arrive in the valley. It is probable that the erection of the plant at El Centro will not be started until September 1st, as the summer heat is too great for best results from workmen who will come from the East to equip the plant. In the meantime material will be assembled and the concrete foundations will be laid, so that rapid progress may be made when the structural work is once started. Mr. Holt expects to be ready to serve gas to residents of El Centro and Imperial by December 1st. Later he will make arrangements to put in gas at Holtville, Brawley and Calexico.

TRANSPORTATION.

HALF MOON BAY, CAL.—L. Coburn of Pescadero is contemplating building a street railroad from Pescadero to Pebble Beach.

LA MESA, N. M.—A franchise has been granted to O. H. Bowen to construct and maintain a street car line between Las Cruces, Messilla Park and College.

ROCKFORD, WASH.—The people of this place have petitioned the Spokane & Inland Electric road to build its proposed line into the Coeur d'Alene Indian reservation through this town.

SACRAMENTO, CAL.—The blockade maintained by the Southern Pacific Company against the Northern Electric Railway Company at Front and R streets, and at Front and O streets, for two weeks has been raised. The Northern Electric may now build its crossings through and over the Front street lines of the Southern Pacific and there will be no derailed cars to retard progress. The officials of the Northern Electric Company have signed up a contract offered by the Southern Pacific Company officials, by means of which the latter road protects its rights and the former pays for the expense of making the crossings.

VALLEJO, CAL.—Captain Charles Hatch of the Monticello Steamship Company, President W. Botsford of the Vallejo and Napa Valley Electric road and Superintendent McIntyre have left for a visit through Lake County in an automobile to determine the best route for the extension of the local road into Lake County and also to try and secure a right of way for the proposed extension from St. Helena to Clear Lake. At present the electric road surveyors are laying out the lines for an extension of the road from St. Helena to a point in the vicinity of the Graystone winery, half a mile north of the city. This section of the road will be constructed immediately, as the rails and ties are already on the ground.

FRESNO, CAL.—The contracts have been signed by the Fresno, Hanford and Summit Lake Railway Company with an Eastern construction company. The contract calls for one million dollars, the amount to be paid out to put the road into operation and the actual grading of the road and laying of track must be started not later than July 15th of this year. In the contract it is provided that the interurban line must be in operation by April 1, 1910. As the preliminary survey work has been completed, all these engineers will do now will be to get the right of way ready for the ploughs, shovels and teams. As soon as the engineers have made a good start along this line, dirt will begin to fly and work will be rushed as fast as possible. The Franklin Construction Company, an Eastern firm, will have charge of the building of the road. The new line will be a standard gauge road and the rails will be of 75-pound steel.

SAN FRANCISCO, CAL.—According to a report from Fresno the lines of the Fresno Traction Company will be taken over by the Harriman interests. A. G. Wishon, the present manager of the street railway lines, is to be superseded by one of the Harriman officials, but his name has not been made public. Local officials of the traction company are still in the dark concerning the proposed change. Among those mentioned to succeed Wishon is Chief Clerk W. Durfy of the local office. Incidentally it has leaked out that a more distinct separation will hereafter exist between the Fresno Light and Power Company on one side and the street railway company on the other. The former is controlled by the Huntington

interests, while the latter is now owned and controlled by a private corporation having its headquarters in Los Angeles. A. G. Wishon is general manager for both companies. If the contemplated entry of the Harriman people takes place Wishon will likely assume charge of the light and power company for the Huntington interests. A. G. Wishon declares that there is absolutely no truth in the report.

OIL.

SANTA BARBARA, CAL.—Surveyors for the Associated Oil Company, who are fixing a route for the proposed pipe line from McKittrick to Gaviota have reached the west slope of Tepusquet grade, and their work is nearly done.

HAINES, ORE.—D. M. Hunt of La Grande has secured the contract for boring a well 2,000 feet deep on the oil lands of the Eastern Oregon Oil and Gas Company, of St. Johns, Ore. Work will commence as soon as the machinery can be placed on the ground.

SANTA BARBARA, CAL.—The Rahn Consolidated Oil Company of Los Angeles, has begun operations on the Higgins place in Carpenteria. A standard rig has been erected by Chas. Bates of this city and three more rigs will be erected in a short time.

SAN FRANCISCO, CAL.—A steel oil-burning tank steamer for the Associated Oil Company for use in the trade out of this port, is under construction at the yards of the Newport News Shipbuilding Company. The vessel is to be finished within a year and will cost $750,000. The steamer will be 390 feet in length, 49 feet in breadth and 30 feet deep.

LEBANON, ORE.—C. W. Taylor, manager of the Cascade Petroleum Company, states that the location of the first well will be definitely decided this week. The company has determined to install a big California Standard rig instead of a Star machine, as first planned, and has placed an order for this with a Los Angeles house. The drillers and rig builders are now at Portland and will be here next week.

BAKERSFIELD, CAL.—The Union Refinery, in the Kern River fields, east of the Standard's tanks, is engaged in enlargement which will almost, if not quite, double the capacity of the plant, and make it the largest refinery in the county. One new 150 horsepower boiler is being installed, and five new stills. There are at present three boilers, of about 60 horsepower each, and six smaller stills. The work will be completed within a few weeks.

PORTLAND, ORE.—Good progress is being made in salvage operations on barge No. 91, owned by the Standard Oil Company, which went ashore near the mouth of the Columbia river several weeks ago. About 17,000 barrels of oil have been pumped from the vessel's tanks and the craft has been floated a distance of half a mile and beached. Sunday she was placed on an even keel and it is expected that she will be towed to Portland during the week for repairs.

MARICOPA, ARIZ.—The Le Blanc well out on the flat has resumed operations after a shut down caused by lack of boiler water. Connections have been made with the Union Oil Company's water well and operations will be pushed rapidly forward. The well is now 1420 feet deep, 7 5-8 inch casing being used at the present time. The Essex, nearby, has reached a depth of 1300 feet with a 10-inch casing. Both these wells are worked on the circulating system by Ben Howe, the superintendent.

BAKERSFIELD, CAL.—All arrangements have been perfected for the projected pipe line from Temblor to McKittrick, and H. B. Guthrey who is interested in the Temblor-McKittrick company, has left for the West Side to arrange for making the trenches for the pipe. All the rights of way have been secured, and the actual work of laying the line will have been begun before the end of June. The new line will be 31,000 feet long and will extend from section 30 at Temblor, across 30, 32, 43, and 11, to McKittrick, connecting with the Associated pipe line. The new line will be four inches in diameter and will have a capacity of about 6,000 barrels a day. It is believed that this line will care for the output of the field for the next two years. The Temblor McKittrick has eight producing wells on its property, the best of which does about 150 barrels a day. The pipe line will have an initial pumping station. Two tanks are to be built of 1,250 barrels capacity, and it is expected that the line will be carrying oil within the next 60 days. The first pipe will arrive on the ground by June 15th.

BAKERSFIELD, CAL.—President St. Clair of the Independent Oil Producers' Agency, says that the survey for the proposed independent pipe line has been completed from Coalinga to McKittrick and rights of way are now being secured for this portion of the route. The right of way for the line extending from Dudley to the Coast has been secured. The pipe has been purchased but not shipped. It will be eight inches in diameter, and will have an estimated capacity of 20,000 barrels per day. The incorporation papers of the pipe line company will be filed probably by the middle of the week.

WATERWORKS.

VENICE, CAL.—The Venice Water Company has let a contract for another 20,000 gallon water tank to the Pacific Tank Company.

PORTLAND, ORE.—Sealed bids are being received at the office of the Port of Portland, City Hall, for steel riveted pipe and special pieces.

SACRAMENTO, CAL.—A contract for furnishing forty dozen water taps has been awarded to the Miller-Enwright Company for $912.

SAN RAFAEL, CAL.—The Board of Supervisors have received from F. Crooker of San Anselmo an application to operate a private water company in Deer Park.

TOPPENISH, WASH.—A special election will be held this week to vote on the question of issuing bonds in the sum of $24,500 for the purpose of installing water and sewer systems for the town.

LEAVENWORTH, WASH.—Permission has been granted to the Tumwater Light & Water Company to use Thirteenth and Commercial streets to the river for the purpose of laying water mains and erecting a pole line therein.

TACOMA, WASH.—The City Council has passed an ordinance providing for the laying of eight, six and sixteen-inch water mains, together with necessary gates, toes, crosses, etc., in certain streets of improvement district 541.

REDLANDS, CAL.—Work will begin in a few days upon a new pipe line for the Redlands Heights Water Company to run from the west end of the Crafton pipe line to the junction of the Heights line with the South Mountain.

SAN FRANCISCO, CAL.—At a meeting of the Board of Public Works this week bids were received for supplying 1200 hydrants to be used in the auxiliary fire system. The lowest was that of the Union Iron Works, at $119.74 each. The next lowest bid was the Risdon Iron Works, at $198.50.

OAKLAND, CAL.—Bids for the construction of a pipe line on the Beck road in Livermore road district, were as follows: L. L. Page, $4945; David McDonald, $5790; H. Gould, $5698.35. The contract was awarded to H. Gould who was allowed 45 days in which to make the improvements.

SAN DIEGO, CAL.—The Southern California Company was yesterday morning empowered by the common council to furnish material for and construct and lay a water main of 6-inch cast-iron water pipe from the present city main westerly to and through Newport avenue in Ocean Beach.